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Extracts from Chordal's Letters.

Mr. Editor:

* * * * I have had a talk this week with Mr. Wyckoff in regard to the use of standard sizing tools in his shop, and here it would be well for me to tell you that this man Wyckoff is no small man. No "pent up Utica," &c., in regard to him. He has a small shop working from ten to forty men in every town in the United States, Europe, Asia, Africa and Oceanica, which pretends to have a machine shop. He has many very extensive concerns in large places. He makes machinery and he manufactures machinery—two entirely different processes. As a manufacturer he is a total failure. His work is not good enough to pass the market; his work costs so much he can't reach the market; he abuses his men in trying to cut this cost down, and thus reduces his capacity largely while again enhancing the cost. Wyckoff is the majority customer, or should be, for economical shop appliances. Sackett don't need talking to. He understands these things, and I much regret that there are "so few of him."

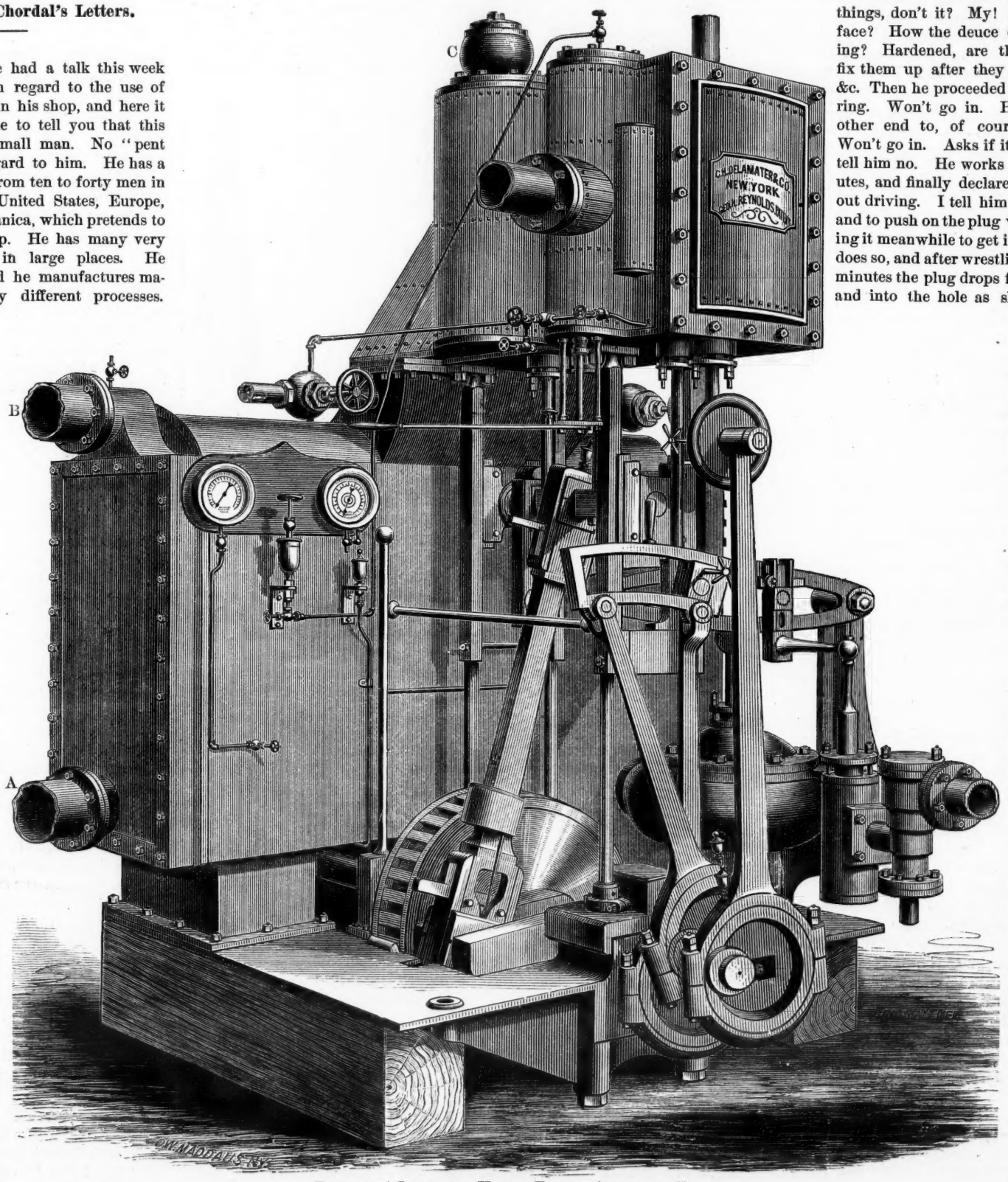
* * * Wyckoff gave me full liberty to talk at him; said he respected my opinions and my motives; knew his work was not as good as Sackett's, but it was as good as he could do for the money he received for it; would cheerfully accept and follow any suggestion I might make which would tend to help his business along; would cheerfully pay out any reasonable small sums if there was a certainty that it would be a good investment, &c., &c.

* * * "Why, Chordal, what are you talking about?" said he, after some other talk; "you have worked at the trade yourself enough to know there ain't any such thing as a thousandth of an inch. Once in a while some smart Aleck comes along from New England and lips off something about half a thousandth, and what not, but you know very well that hundredths are finer than men can work. Why, bless your soul, if I tell Frank to bore one hole two inches, and another hole two and one one-hundredth, ten chances to one the small hole will be the biggest. Now, what's the use of talking about thousandths? There ain't any such thing in machine work. It's all Yankee blow. Just look here, Chordal; there is a scale graduated to hundredths; just look at those marks; you can't divide *them;* you can't even pick out the right one with calipers, let alone splitting them half a dozen or ten times. I tell you I worked thirty years at this trade, and I know how close a man can caliper. You tell me my two-inch shafting ought not to vary, the year round, a thousandth of an inch, and I tell you there is no way to help it, and besides that a thousandth don't make any difference in machine work, anyhow."

* * * * Wyckoff is the type of the shop-owner generally met with. I wish you to understand this fully. He is not a bad man or a bad machinist or a bad manager. He is simply a common one, as distinguished from the extra fine men, &c. He said a thousandth was nothing; that if a man made a driving fit and took a thousandth too much off the drive would not be quite so tight, but no harm would be done; that a hundredth was fine business.

I was prepared to preach to Mr. Wyckoff, and had the examples in my pocket. I took out a little half-inch plug and ring gauge made by Pratt & Whitney. Here is a cut of it. (See Fig. 1, page 2.)

Wyckoff's eye caught them. "Hello! Gosh, that's nice; ain't it? Pratt & Whitney, eh? takes the Yanks to make nice things, don't it? My! ain't that a fine surface? How the deuce do they do that milling? Hardened, are they? How do they fix them up after they temper them?" &c., &c. Then he proceeded to put the plug in the ring. Won't go in. He turns the ring the other end to, of course, and tries again. Won't go in. Asks if it is made to drive. I tell him no. He works with it for ten minutes, and finally declares it won't go in without driving. I tell him to set the ring level and to push on the plug with one finger, steering it meanwhile to get it started straight. He does so, and after wrestling with it about three minutes the plug drops from under his fingers and into the hole as slick as grease. He snatches it up in astonishment and works the plug back and forth in the ring. It tickles Wyckoff, and would tickle any appreciative mechanic to work such things together. The fit is perfect. It feels like glass fitting in velvet. No lumps, no taper, no nothing but perfect uniformity. Wyckoff works the thing and talks. "By Judas, but that's nice. Who'd a thought that plug would go in that hole? And it ain't tight, either; is it? Just a nice fit; ain't it?" While he is talking he works the plug less and looks at it more. Pretty soon his countenance changes a little. He feels as though something was happening to the gauge. He changes from his delicate finger grip to a broad and heavy hand grasp. The thing gets tighter. He bends his elbows and shows his teeth and twists and twists and twists, and the plug never moves in the ring. He looks puzzled and sold out. He knocks it endwise on the desk to drive it. It don't budge. He lays it down inquiringly. "Does heat do it? Does something expand?" I tell him no; that the minute globules of oil, kept in circular form by centrifugal force so long as he kept things in motion, flattened as soon as he stopped, and thus took the wheels away and left heavy contact sliding friction instead of rolling friction, &c. I told him the plug would have to be driven out. We went out into the shop and found a hole to stick the thing through. We wanted something to drive on. Wyckoff suggested a prick punch, of course, and I suggested a wooden plug. We found one, and the plug was finally driven out. Wyckoff picked the gauges up



REYNOLDS' IMPROVED YACHT ENGINE (SEE PAGE 2).

and put them right together again as nice as anything, and this time he was sharp enough to pull the plug out before he let the thing rest.

* * * * I now took from my pocket another plug apparently just like the first one. It had a flat place filed on the handle. Wyckoff took this plug and stuck it in the ring. It was loose; it shook in the ring; he could see big daylight through the fit. He said there was nothing nice about that fit. There was nothing charming about it like there was in the other. Then he tried the big plug again, then the little one, and then the big one again, seriously and studiedly. Now, says I, Wyckoff you know how those two plugs fit in the ring; tell me how much difference there is between the two plugs.

He looked and tried again, and squinted, and looked wise, and thought solemnly of the graduations on a scale, and then said: Well, I think its about—well, say—I should say—well, just about—say a hundredth of an inch—no—well—yes—wait till I call Port in—I say about a hundredth, and we'll see what Port guesses. Port comes in and goes through the whole process under Wyckoff's directions. Pratt & Whitney ought to see the show. Port, after the process, puts his figure at the hundredth and twenty-eighth part of an inch, that is, he mentally splits a sixty-fourth. Then he must call in Gus, who is the crack lathesman of the shop, and then Mac, who is a smart chip, and then George, a fine New England workman, who is turning mill pulleys. The exhibition is over and the guesses all in. All are mightily interested. Gus says a sixty-fourth scant; Mac says a two-hundredth; and George shakes the loose plug two or three times, while his thought shakes in unison, and he guesses at half a thousandth. He has handled gauges before, and has done some blowing before, and the laugh is on him. Then Wyckoff wants to know what the real difference is. I tell him it's a thousandth of an inch, and all look incredulous. Why, says Port, that would spoil any kind of work, yes, half of it would, yes, by George, the fifth of it would. You don't mean to say that's only a thousandth of an inch. I assured him I did; that I had these gauges made to show Wyckoff the real value of a thousandth; that this showed that the men in the shop were working and must work closer than thousandths every day.

Wyckoff said he was completely beat. Wouldn't have believed it; but just for a joke he would like to give a quarter to see how much a hundredth was. I quickly pocketed his quarter and produced the third plug from my pocket; one-hundredth of an inch smaller than the one which fit. Wyckoff tried this one, and said: "Why, Mr. Chordal, I would have sworn that was a full thirty-second smaller than the hole. I had no idea I worked at as fine a business as I do. If that middle plug is only a thousandth small, I have worked to quarter-thousandths myself when I worked at all, only I didn't know it." He was interested, and got a pair of calipers. "Yes, there's a big difference; enough to spoil any kind of a fit; but see here, Chordal, try these calipers on this nice scale; you or no other man could tell whether those calipers were set at an exact half inch or a thousandth, or even a hundredth, large or small."

Those gauges are surprising, but I can't caliper any closer than before. I see now that a man can work, or ought to work, way inside of the thousandths; that one piece of line shafting a thousandth smaller than another won't fit the same pulleys at all, at all; but, since you have commenced, I want to know how it is to be helped. How are you going to fix things so the men can set their calipers any closer to the size ordered, than they usually do? If I go out and tell Gus to turn a piece exactly a half inch, I don't know whether it would fit in that ring like the big plug, or like the middle one, or like the little one, or whether it would go in at all or not; and I know mighty well if I got Gus to turn one nice piece, and got Frank to turn another nice piece, they would certainly vary in size as much as that little plug does from the biggest one.

I now went down in my pocket again and produced a Brown & Sharp micrometer caliper like this. (Fig. 2). This well-known little tool was a new one on Wyckoff. I explained that the screw (*c*) was 40 threads, and that consequently each full turn of the thread made a fortieth or twenty-five thousandths of an inch; that the turning sleeve had twenty-five divisions on it, and that consequently turning the sleeve one division, would open the caliper the twenty-fifth part of twenty-five thousandths, which would be one one-thousandth of an inch; that the divisions may be easily divided by the eye so that half and even quarter thousandths can be measured; that the line of exposed graduations on the hub *a* were fortieths of an inch or twenty-five thousandths each.

Wyckoff saw it all in a minute and commenced calipering hair and twist drills, and his little finger and every other thing he could pick up. Now, said I, "set that caliper at twenty fortieths and the sleeve zero on the hub zero line." He did so. I handed him the big plug. By George, Chordal, that fits to a dot, don't it?" said he. I told him to turn the sleeve one division and thus close the caliper a thousandth, and then gave him the middle plug. "Got it again," said he. Then he turned the sleeve ten divisions and the smallest plug fitted exactly.

"Now," said I, "you see that this does

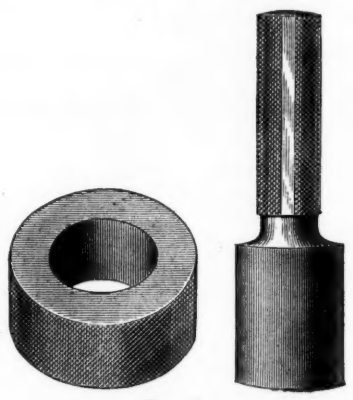


FIG. 1.

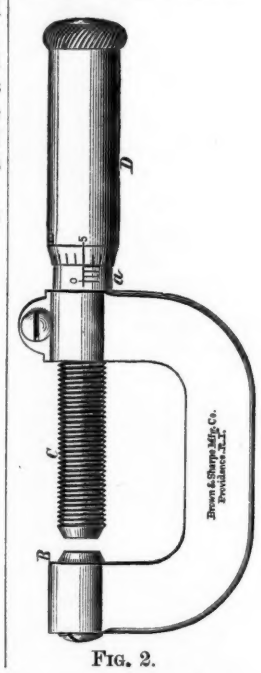


FIG. 2.

FIG. 3.

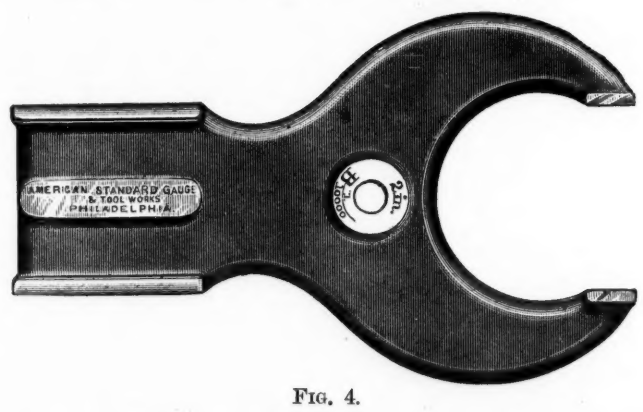


FIG. 4.

more than caliper; it measures. You can see that Gus and Frank could get two pieces near alike by the use of such a tool. Here is the poor little thousandth, you have denied the existence of, brought right to your hand and shown to be big and important."

* * * * "Chordal," said Wyckoff, "I want those plug gauges." I told him he couldn't have them. Told him to send and get a set and not lock them up in the safe when he did get them either, but to let the boys have them to take home and fool with." "All right," said he; "but can I get that caliper business, too?" "Yes," said I, "you can get all you want. They only cost five dollars, and you will find lots of New England workmen using them. I am surprised that you never saw one before." (I was not surprised, though, for I knew no man by the name of Wyckoff ever did see one). Wyckoff said he would give me five dollars and a pocket full of cigars for this caliper. I took the cigars only, and gave him the caliper. No colporteur ever felt the blessing of giving more than I did.

* * * * Wyckoff asked me if they didn't make big ones; said a man couldn't do lathe work with this size. I told him I wasn't half done with him yet; that these calipers were for nice and accurate measuring, and not for calipering. Said I, "suppose you had a pair of outside calipers set nicely to say two inches, and fitted to a two inch plug like these little ones, wouldn't such a caliper keep your two inch work uniform and save all the time of setting calipers to scales?" Yes; he thought it would; and then suddenly said he saw the trick exactly. Make a lot of solid calipers and let the boys use them. I told him he had hit it exactly, only he would be foolish to try to make them. He could buy them for half, yes a third, the cost of making them from, Brown & Sharp, Pratt & Whitney, or the Betts Machine Company of Wilmington, Del.

* * * * I went down in my pocket again and brought up a Wilmington caliper, two inches, like this cut. (Fig. 3). Wyckoff said, if he didn't know my missionary traits, he would take me for a drummer with a full line of samples. "Now," said I, "here's your rig. This caliper is steel, and hardened. It is accurate, and can be kept so. One end is male, and is not liable to lose its size. The other will lose size, and you must have something to size it back to. Get a set of plugs, or their equivalent, and never use the plugs for any purpose whatever, except to size the calipers as they wear big."

"A better form than plugs is a lot of collars strung on a bar. They don't need to be steel, or hard, as there is no wear on them, but you should get them where they are fixed for making them. Don't think of making poor ones when you can get good ones cheaper. Here is one made by the Wilmington people. (Fig. 4). You can get any sizes you want put on these handles. If you figure on all you want, you won't get any; so get only what you need in regular work to start on.

That will be $\frac{15}{16}$, $1\frac{1}{16}$, $1\frac{3}{16}$, $1\frac{5}{16}$, $1\frac{7}{16}$, $1\frac{9}{16}$, $1\frac{11}{16}$, $1\frac{13}{16}$, $1\frac{15}{16}$, $2\frac{3}{16}$, and $2\frac{7}{16}$. This will show you how much can be done in the way of cheapening and "nicening" work by simple aids. You haven't got a reamer in the shop, and you don't have to get one, to start a system of securing uniform sizes. After you find out how much value such systems are, you won't do a minute without reamers.

When you get these tools, lock the correcting gauge up, and hang the calipers on a board, and place them in the custody of a smart apprentice. Make him the tool keeper. He will see them kept in place and to size, and, some day, you will have a tool room without knowing it."

* * * * Wyckoff has sent for these things, and you may be interested in knowing the result of his venture. I shall keep you posted. I consider that I have started the thin edge of an economical wedge into Wyckoff's shop. Talk of reamers, and gauges, and calipers, and tool rooms, and tool men, and grinding, all in one breath, and Wyckoff would think the thing a contrived plan to break him up in business. As it is, he pays out little money, and sees returns wherever he looks. Let's see. The eleven calipers will cost him thirty dollars, and the correcting gauge, with eleven steps, should not cost over ten dollars. This is a good investment, and, some day, I expect Wyckoff can fill an order for bridge bolts, in which one nut will fit on either end of a bolt. He can't do it now.

Very respectfully,

CHORDAL.

Reynolds' Improved Steam Yacht Engine.

The illustration shown on the first page represents an engine of novel design, which is used for the purpose of driving the steam yacht, Ideal. The principal dimensions of the hull are, viz., length on deck, taffrail to knightheads, 130 feet; do. at water line 110 feet; breadth, moulded, 20 feet; depth of hold 8 feet; draught forward 5 feet; do. aft 7 feet. The hull was built by the late J. B. Vandusen, and the engine by Mess. C. H. Delamater & Co., foot of West 13th Street New York, from designs, and under the patents of Geo. H. Reynolds. The first peculiar feature of this engine is, that it has no frame like ordinary engines, but instead, the single cylinder, 20″ diam. × 20″ stroke and is mounted upon four steel bars attached to the binders of the pillow blocks. The lower parts of these bars are turned, and the upper part is planed $2\frac{1}{4}$″ square, and are thus made to serve a double purpose; for while they act as a support to the cylinders, they also perform the office of guides and holding down bolts. The reader will observe by the illustration, that there are two piston rods which are both connected to the same crosshead, with the main rod connected between them. The engine is thus made light, and the inventor claims to secure the requisite amount of firmness, by the manner in which the cylinder is bolted to the condenser. The flange at the joint is made of extra length athwartships, so as to fully meet the resistance when the crank is on the quarter.

The air pump is 14″ diam. × $6\frac{1}{2}$″ stroke and is driven by a beam connected by links to the main crosshead. The manner in which it is secured to the channel way in the bed plate, in relation to its position with the surface condenser is such, that the discharge valve of the air pump, and the bottom of the condenser are on the same level; so that the water in the condenser can always prime the air pump. By this simple arrangement, the air pump bucket is not required to lift the the water of condensation, but simply to displace it—this is considered a very desirable feature in sea going vessels. The condenser is of a type that can be used either as a "surface or a jet" condenser; when used as a surface condenser, the sea water is forced by an independent circulating pump, through the lower nozzle of condenser, shown in cut, and marked *A*, through the lower half of the tube, and returns through the upper half and out through the upper nozzle marked *B*. It has about 660 tubes $\frac{5}{8}$″ outside diam. × 6 feet long, which gives a cooling surface of about 650 sqr. feet. In case the condenser should be disabled from performing its work as a surface condenser, it can be used as a jet condenser; and should the air pump become disabled in any manner, it can be disconnected, and by means of the automatic high pressure exhaust valve, marked *C*, on top of the exhaust jacket, the engine can be run as a high pressure engine without adding to, or disturbing any of the parts, thus this most important part of the modern surface condensing yacht engine, is so arranged as to meet any emergency that may arise in sea cruising.

The arrangements for handling this engine, that is, for stopping, starting, and backing—for an engine of this size is the most com-

plete of any that our attention has ever been called to. It will be observed by looking at the cut that there is no reversing lever, or wheel, with its attachments connected to the valve link nothing but a simple handle on the top of the link; the engineer can, by simply slacking the screw, to which is attached a wedge which jams the link block in the link, and at the same time closing the throttle valve, move the link back and forth over the link block, and moving the slide valve the necessary amount to reverse the engine, this is accomplished by forming in the throttle valve (which is a rolling one) a port which connects from the steam chest to the exhaust chamber, so that when the throttle is closed, the connection from steam chest to exhaust is open, and steam pressure is taken from the back of the slide valve, and in reversing the link, all the resistance to be overcome is simply the friction and inertia of the valve connections; in fact if the wedge which jams the link block in the link is left lose, and the throttle is shut and then opened, this link, through the motion of the engine, will *reverse itself*. On the back of the main slide is a cut off valve, controlled by a right and left hand screw operated by the hand wheel, shown in connection with the cut off stem.

The propeller shaft is 6″ diam.; diam. of screw 6 feet 8″, pitch 11 feet, revolutions 135 with 75 lbs. steam cutting off at 11″ of the stroke, shaft journals 7″×9″, crank pin 6″×7″, main connecting rod 50″ long. The boiler is of the return tubular type, and is intended to carry 80 pds. pressure to the sqr. inch. This vessel has steamed 100 miles in 6 hours, and has probably been one of the most sucessful ocean steam yachts built in this or any other country. We think that this engine is worthy of a close examination by engineers, and may be studied with benefit by those who are anxious to develop still farther these improvements in yacht engines.

Laying Out Gear Teeth.

BY V. HOOK.

The plan here presented for the formation of the teeth of gearing can be relied on. The piece *A* is of wood, about ½ in. thick, screwed on to *B*. The circle of *d d*, forming the edge of *A*, is the pitch circle of the larger gear. The piece *C* is of the same thickness as *A*, and the diameter of the circle from which it is struck is one-half of that of the gear intended to work into *A*. The width of the tooth is laid off on *A* as *b c*, and a brad-awl point *a* inserted in *C* at the edge of its circle, will, when the piece *C* is revolved, partially trace the part of tooth above the pitch line as shown, *b f*, being the line traced. The line *c g* of the opposite face is traced similarly. A line is now traced on *B* from edge of *A*. This line is shown in Fig. 2 at *d e*. The line *f g* is the top of the tooth, and *h i* the base or root line. Two lines, *j k* and *j l*, are drawn from center *j* to width of tooth on the pitch line, and give the outline of the flanks. In pinions the flanks will be somewhat undercut, especially so if the pinion is very small. Now, as the points of the teeth when in operation do not come in contact with the flanks of each other, much below the pitch line, the root of the tooth may be strengthened by corners as shown by the black portion in Fig. 2. The height of these corners depend on the individual case, and can be ascertained in laying the gear out. The shape of the tooth as obtained may be cut out in tin, and by means of the central line, *m n*, be transferred to the tooth blanks of the pattern; the line *m n* being placed fair with similar lines, on the blanks obtained from the spacing. This template will also serve to fit a cutter to, if the gear is a cut one. The portion of the tooth of the pinion above the pitch line is obtained by similar means; that is, the diameter of the circle of the piece *C* is half of the diameter of the longer gear, and the line *d c* will then be the pitch line of the pinion. The following proportions in fractions of the pitch will be found correct: The pitch being 1, the thickness of the tooth should be .45, width of space, .55; play, 1; length above pitch line, .35; length below pitch line, .40; working length of tooth, .70; whole length of tooth, .75; clearance at root, .05. The play or clearance depends on a great many different conditions. If the gear is a cut gear and correctly proportioned, the clearance may be reduced to .09, and less. Cast gears must have considerable clearance. This depends on the smoothness of the pattern and its draft, some gears coming out of the sand with little or no "rapping," others again requiring considerable. It is evident that if a gear pattern is correctly laid off, and a minimum of clearance allowed, if from any cause excessive "rapping" was required in drawing it, the clearance might be all "rapped" away, and hence the clearance depends very greatly on the correctness of the pattern-maker's work. The writer has seen a gear pattern moulded by piece work by one moulder, which worked nicely, but on giving the same to the next man to make, would come out with no two alike as to clearance. One-tenth of the pitch for clearance in cast gears will do, if the pattern is correctly made and moulded.

The strength of the tooth can be found as follows: If the gear is to transmit a given number of *H. P*, each tooth ought to be strong enough to take the entire strain. To get the strain on each tooth, divide the number of feet in one *H.P* (33,000), multiplied by the number of *H.P*, by the circumference of the pitch circle multiplied by the number of revolutions of the gear; that is

$$\frac{\text{Number of } H\,P \times 33{,}000 \text{ feet}}{\text{Circumf'nce of pitch line} \times \text{No. revolutions.}}$$

= strain in lbs. on each tooth, the circumference of gear being taken in feet. The tooth then becomes a beam supported at one end and loaded at the other, and by dividing the product of the strain and length of the tooth *in feet*, by the value of cast iron for this purpose, which is from 60 to 100, the quotient will give the product of the length of the face of the tooth and the square of the thickness. It is assumed that the length and thickness of the tooth are known, and the necessary strength may be arrived at by the width or length of the face of the tooth. Thus by multiplying the thickness of the tooth by itself, we will obtain its square; and by dividing the product of the length of the face and square of the tooth's thickness, by the square of the thickness, we will obtain the length of face necessary to transmit the strain at the given speed with safety.

Horse-Power of Steam Boilers.

BY JOHN W. NYSTROM, C. E.

The question of "horse-power of steam boilers" has been frequently asked since the time of Watt, but no satisfactory or legitimate answer has been made generally known to the steam engineering profession, and the subject remains yet in obscurity, as evinced by seekers for such information through scientific periodicals.

In the year 1870, the Franklin Institute of Philadelphia, Pa., appointed a committee for the purpose of establishing a rule for determining the horse-power of steam boilers, which committee labored on the subject for some three years, in which time they searched for that power in books, and wrote to Europe for it, but could not find the same; whereupon, it was recommended to abolish the term "horse-power of steam boilers" as being "a misnomer that conveyed no definite idea of the power of the boiler." The committee was finally discharged without having solved the problem.

In the *Nautical Gazette*, Dec., 1875, an engineer of the United States Navy declared that "there is no horse-power in a steam boiler, but only in the engine."

The power in a steam boiler is generated by the *heat* of combustion, which penetrates the iron from the furnace into the water, and evaporates the latter into steam.

Without heat and evaporation, there is no power in the boiler, but the term "horse-power of a steam boiler" means the capacity of the boiler to accommodate that amount, or rate, of combustion and evaporation that corresponds to the power generated. It is, therefore, perfectly correct to rate, or nominate, the capacity of steam boilers by horse-power.

There is no power generated in the steam engine, which only transmits the power from the boiler to where the work is done. It is, therefore, incorrect to rate steam engines by horse-power, because one and the same engine may be capable of transmitting widely different horse-powers, depending upon the speed with which it is running. A small engine may be capable of transmitting much more power than a large one. The engine depends entirely upon the boiler for the power transmitted, whilst the power generated in the boiler is independent of the engine.

In the year 1875, the writer was requested to clear up the question of horse-power of steam boilers, by parties, concerned in lawsuits about performance of boilers, which request was complied with and the result published in a pamphlet by John Penington of Philadelphia.

"In one case a boiler was contracted for, to generate one hundred and fifty horse-power, but on trial it was found by indicator diagrams from the engine to be only one hundred and fifteen horse-power. The boiler-

Fig. 1.

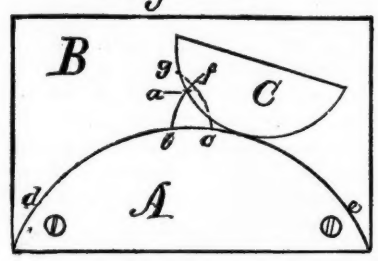
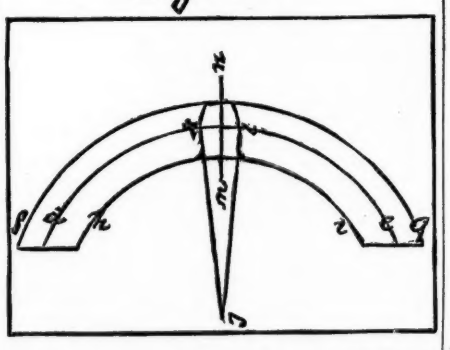


Fig. 2.



maker then contended that the deficiency was the fault of the steam-engine, whereupon the same boiler was tried, under similar firing, with another engine, when it was found to generate over two hundred horse-power. Cases of that kind occur frequently, showing that the indicator diagrams are not a correct measure of the real steaming capacity of a boiler.

"The horse-power of a steam-boiler can be ascertained correctly by the quantity of water evaporated per unit of time, independent of the steam indicator diagrams or performance of the steam-engine, supposing that all the feedwater is evaporated and nothing carried over in form of foam, known as priming.

"The question may arise whether the steam-pressure of the horse-power should be taken above vacuum or above atmospheric pressure. The boiler-maker may argue that the steam generated in his boiler drives out the atmospheric pressure, and thus claim the rsght to be credited for all the power supplied from his boiler to the engine.

"The steam user, on the other hand, cannot realize all that power for his work, and he is therefore unwilling to pay for more than value received, and as the boiler-maker does not undertake to remove the atmospheric pressure which is partly done by the engine-builder making a condensing engine, the power of the boiler should include only the pressure indicated by a proper steam gauge or safety valve, which is the pressure for estimating power of a non-condensing engine.

"The horse-power given by the indicator diagrams depends much upon the construction of the engine and the grade of expansion of the steam, with which the boiler-maker has nothing to do.

"The legitimate horse-power of a steam boiler fired, by a given kind or quality of fuel, should therefore be that passing from the boiler through the steam-pipe, independent of the power given out by the engine. A condensing engine working with a high degree of expansion indicates much more power per water evaporated than does a non-condensing engine, working with full steam.

"The boiler-maker should be careful to have the height of the chimney connected with his boiler clearly specified in the contract, also the steam pressure to be used.

"It has been attempted to hold boiler-makers responsible for the action of physical laws which are not under their control."

DETERMINATION OF HORSE-POWER, PER EVAPORATION.

Suppose a cubic foot of water to be evaporated per minute under a steam pressure of eighty pounds to the square inch above vacuum. The volume of steam of that water will then be 328 cubic feet, which will fill a cylinder of one square foot section and 328 feet long. The pressure on the piston in that cylinder will be 144×80=11,520 pounds. The horse-power of this operation will be:

$$\frac{11{,}520 \times 328}{33{,}000} = 114 \text{ horse-power.}$$

Thus, the horse-power of any steam boiler can be calculated when the rate of evaporation and steam pressure are known. The volume of steam corresponding to the pressure can be found in Nystrom's Pocket-Book.

In the above example, the steam pressure was taken above vacuum, which gives the true power developed, but which cannot be wholly realized in practice. The steam pressure should be above that of the atmosphere and the volume for that above vacuum.

$$\frac{144 \times 65 \times 328}{33{,}000} = 93 \text{ horse-power,}$$

should be the practical rate of that evaporation.

HORSE-POWER OF STEAM BOILERS PER RATE OF EVAPORATION OF WATER TO STEAM.

Steam pressure above atmosphere.	Water evaporated per hour per horse-power.			Horse power per cubic ft.
	cub. ft.	cub. in	Lbs.	
10	1.3983	2416	87.23	0.715
20	0.9654	1668	60.22	1.036
30	0.8176	1412	51.01	1.223
40	0.7412	1281	46.24	1.349
50	0.6935	1198	43.26	1.442
60	0.6600	1140	41.18	1.515
70	0.6349	1097	39.61	1.575
80	0.6149	1062	38.36	1.626
90	0.5983	1034	37.33	1.671
100	0.5847	1009	36.45	1.711
110	0.5720	988	35.68	1.748
120	0.5611	969	35.01	1.782
130	0.5513	952	34.59	1.807

DETERMINATION OF HORSE-POWER PER AREAS OF FIRE GRATE AND HEATING SURFACE.

It is often required to determine the horse-power of a steam boiler by its size, that is, the areas of the fire-grate and heating surface, which is particularly the case in the construction of a boiler, or when it cannot be conveniently tested by actual evaporation.

For the ordinary proportions of steam boilers, that is, when the heating surface is between twenty and thirty times the area of the fire-grate, the following rule gives a close approximation to the actual evaporating power.

Rule: Multiply together the areas of the fire-grate and heating surface, and the square root of the product multiplied by 0.4 gives the evaporation of water in cubic feet per hour.

Example: The fire-grate is 20 square feet and the heating surface 500 square feet. Required the evaporation:

$$0.4\sqrt{20 \times 500} = 40 \text{ cubic feet per hour.}$$

Having this data given, the horse-power is found as before described.

Suppose the boiler to be strong enough to bear with safety a working pressure of 80 pounds to the square inch. Required the horse-power of the boiler.

In the above table will be found that for 80 pounds steam pressure, there will be 1.626 horse-power per cubic foot of water evaporated, and consequently 1.626×40=65.04 the horse-power required.

The longest felt want of this mechanical age is a machine that will either supersede the use of kerosene in lighting fires, or utilize the remains of the household help, who are charred at the post of duty.

How to Set a Slide Valve.

Perhaps the following directions for setting a plain slide valve may be of use to some of your readers, especially as I have never seen or heard a correct and complete method in any of the too numerous "hand books," etc. It is first necessary to find the two centers for the cross-head. A, in Fig. 1, is the rim of the fly-wheel, and B, a piece of wood of a length to reach from the floor or foundation to about the height of the center of the shaft. On the guides A, Fig. 2, draw a line *a*, at or a trifle beyond the travel point of the cross-head. Measure off a short distance (2, 3, 4 or 5 in.) on the guide from line *a*, and draw the line *b*. Place the cross-head as near on the center as can be done with the eye, and turn the fly-wheel, the crank pin traveling up till the cross-head arrives flush with line *b*, as shown, B being the cross-head. Then with the stick resting on the floor or foundation, and against side of fly-wheel, make a mark *a*, Fig. 1, as shown. Now return the cross-head to the center, revolving the fly-wheel in an opposite direction to that in which it was first moved, till the pin passes the center and travels down, and the cross-head has again arrived at line *b*, as shown in Fig. 2. The stick B remaining in the same position, another line *c*, may now be drawn flush with the end of the stick. The center between *a* and *c* may now be found, and drawn as *b*. Now, when the line *b* is brought flush with the end of the stick by turning the wheel, the cross-head will be on the center. A similar operation for the other center will also ascertain it. The length of the eccentric rod is next in order, and should be lengthened or shortened as the case may be, till the valve opens one port about or nearly as far as the other. While doing this the position of the eccentric makes no difference, and may, in fact, be fastened anywhere. Having approximated the correct length of the rod, place the engine on the center (either). The direction in which the engine is intended to run being known, the position of the eccentric must be ascertained. If the engine has a rocker shaft, the full part or belly of the eccentric will follow the crank pin; if there is no rocker shaft, the full part of the eccentric will lead the crank pin, being in either case nearly at right angles with the pin. The engine being on the center, as in Fig. 3, and, having no rocker shaft, we will suppose it is to run in the direction of the arrow. As the eccentric in this case leads the pin, it will be in the position of A. Now adjust it till the required lead appears at *a*, fasten it, and try the lead when the engine is on the other center. Whatever difference there is in the lead, lengthen or shorten the rod till the lead is equally divided on both ends, not moving the eccentric till this is accomplished, and when it is, shift the eccentric to the crank if there is too much lead, and from it, if there is not enough.

The center of the eccentric, *b*, will then be the lap and lead from the center line, *c c*. If the engine was to run in the opposite direction, the eccentric would occupy the position of B. That the position A is the correct one, is evident from inspection, for imagining the pin *p* to commence and travel in the direction of the arrow, it is evident that the eccentric A will drive the valve from left to right, opening the port *a* as required. If we connect the valve-stem to eccentric B, and suppose the pin to still travel in the direction of the arrow, the eccentric would drive the valve from right to left, and close the port *a*, and it is plain that B is not in the correct position for the direction of the arrow. However, if the engine is to travel in the opposite direction, it at once becomes evident that B is in the correct position for that direction. In either case, the valve occupies the same position when the pin *p* is on the center. Locomotive engineers will find in this fact an explanation for setting a slipped eccentric, by throwing the reverse lever in the opposite direction to the slipped eccentric, marking the valve-stem, throwing the lever in the motion for the slipped eccentric, and shifting the eccentric till the mark on the valve-stem reappears in the same relative position as when it was made, as the valve occupies the same position when the engine is on the center, whether the engine runs forward or backward. By examining Fig. 4, it will be seen that the rocker-shaft makes all the difference in the world—in fact, the eccentric stands opposite to what it

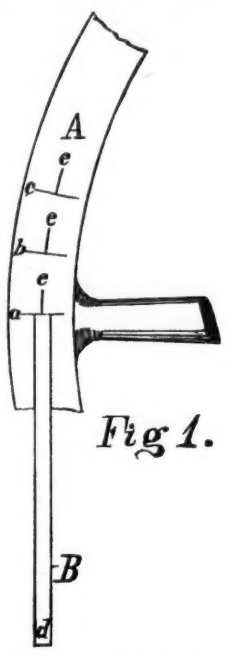


Fig 1.

would without the rocker-shaft. When the engine runs in the direction of the arrow, the eccentric pulls the eccentric-rod in the direction of the arrow under it, and drives the valve-stem in the direction of its arrow, from left to right, as is required. The rocker-shaft just reverses the order of things, that

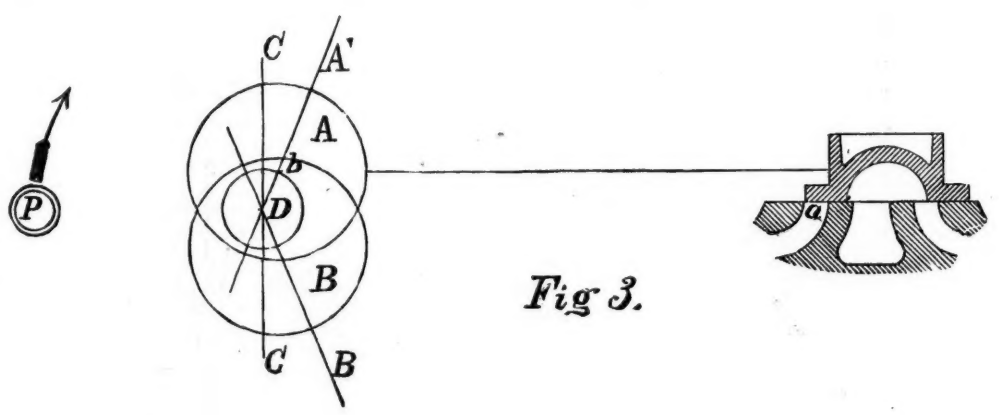


Fig 3.

is, it causes the eccentric to be the lap and lead *nearer* to the pin from a center line *c c*, and also *follow* the pin, while without the rocker-shaft, the eccentric is as seen in Fig. 3, the lap and lead further from the pin from the line *c c*, and it also *leads* the pin. When the rocker-shaft is used, it should stand at right-angles with the valve-stem, when the valve is over the center of the seat.

Yours,
V. HOOK.

Boiler Proportion and Construction. Man-holes, Stays, Hand-holes, Side Seams, Caulking, etc.

BY WM. H. HOFFMAN.

The use of cast iron man and hand-hole frames and plates should be discontinued. Our rolling mill engineers can do most anything in the line of irregular forms at this date, and there is no excuse for using a metal entirely unfit for the details mentioned. About one fifth of the boiler explosions almost daily occurring, can be traced to the use of cast iron in construction. I have seen man-hole frames on boilers carrying 80 lbs. pressure, that if actually tested, with a view to rupture, would break at 130 lbs. distributed in the same manner as the steam load. Let all builders adopt wrought iron for the parts here under consideration, discountenance this dangerous practice, and the record of boiler explosions will surely be smaller. When wrought iron is used for frames and plates,

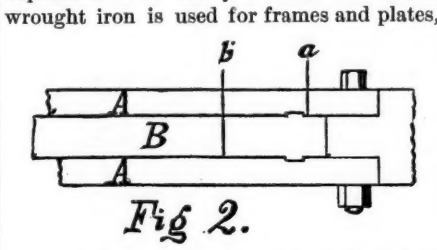


Fig 2.

two man-holes can be placed above the tubes, in shell, with as much safety as one, each one say 11″×15″, the hand-hole in front head *under* tubes should never be less than 7″×10″, on a 66″ shell boiler I make it 9″×12″, the common size hand-hole is of very little use in cleaning never, being larger than 5″×7″, the majority 4″×6″.

The *head* stays above the tubes should be continuous in design, with eye sockets and pins at the heads, the rods or bars separated in their length at the center, and coupled and drawn together with taper keys, wired in position, to prevent displacement. The stays can then be taken out and examined when cleaning, an item of as much importance as any other part of boiler inspection. The bolts and clamps, or guards, for holding plates in position, must be large, the threads

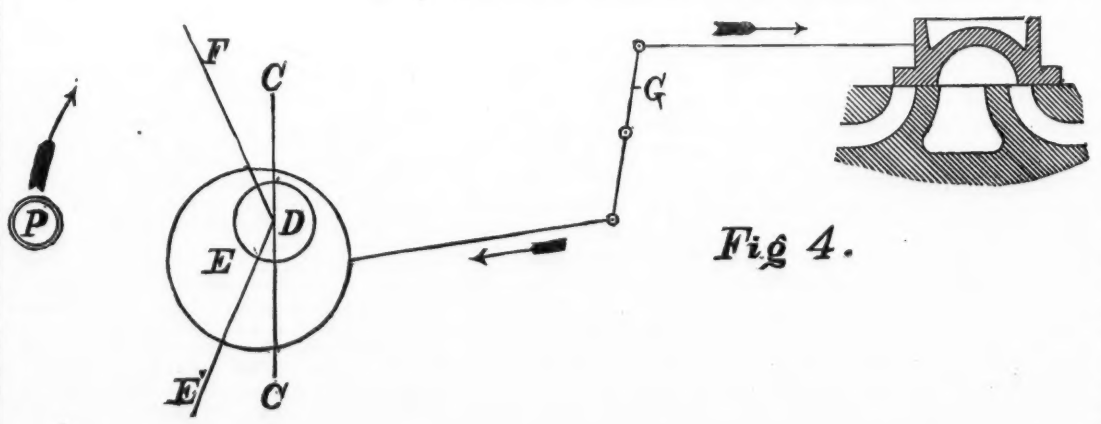


Fig 4.

of bolts of the half V style to resist hard usage, while the clamps should be *faced* on feet and hubs. All boilers should be double riveted on the horizontal seams. Even with this precaution in construction, they are not as strong at the point of riveting as in the solid portion of sheet.

As for caulking, Connery's concave system will be of as much service in boiler making, in the matter of saving material and preventing accident, as any invention introduced within the last twenty years. Hundreds of good boilers have been ruined in caulking, and many a boiler maker has repaired his own work knowing, after examination, that *his caulkers* were responsible for the damage. Machine tools must be used in preparing sheets, such as straightening, bending, flanging, drilling and scarfing, or planing, and in *assembling*, riveting. The old sharp-edged caulking tool was always wrong, the same as hand riveting is in principle, and, in the hands of an inexperienced man, the most dangerous of all devices used. It will pass away, however, and good results will certainly follow its disappearance.

Mr. James W. Connery, of the Baldwin Locomotive Works, deserves honorable consideration from the mechanics of this country, for his scientific and simple method of dispensing with a mischievous article of *destruction* as well as construction, and I hope he may be pecuniarily benefited in the same proportion that he has assisted the mechanical world in boiler construction. * * *

Passing from the consideration of the foregoing points, to another important branch of the subject of boiler construction, I will speak of steel plates and their advantages.

The best steel plates, though quite mild in quality, show entirely different results in working from wrought iron.

Any attempt to do even ordinary flanging by *hand*, at more than two heats, is liable to be met with failure, and one heat shows better results on the plate when cold.

The portion of plate to be turned must be wholly exposed to the fire, and that at as high temperature as safety will admit; while good wrought iron plates can be heated a portion at once in several heats if desired, only a moderate fire being necessary.

In handling steel plates, if proper machinery is used, it is much better to bend or turn at *one* heat; the plate is then perfectly safe from straining or fracture, besides the chances of burning are very much reduced. The tensile strength of steel plate for flanging should not exceed 78,000 lbs. per square inch of section, and working on this basis, a saving of from 20 to 25 per cent. can be made in the weight of a boiler, where steel is used instead of wrought iron.

Another decided advantage in using steel plates, is, that the rivet holes do not *stretch* under heavy pressures as much as iron, a very important point, as it is under any circumstances almost impossible, to fill a rivet hole perfectly, on account of the shrinking of rivets while cooling. A great deal is said about the grip the sheets get, by the shrinkage of the rivets in the direction of their length while cooling: this is very true, and the same law that shrinks them in that direction, operates in reducing their *diameters* to such an extent, that seven out of ten rivets do not fill their holes when cold, and when you add the stretching of an iron *punched* sheet to this difficulty, you have a riveted joint, ripe for shearing under sudden and undue pressures or shocks.

In places where the fire is in direct contact with the boilers, I do not believe in making the sheets much less in thickness, than that now generally adopted when *iron* is used in construction, and if corrosion is the same with both metals (steel and iron), which is doubtful, the thicknesses must be about the same in each case; but there is very good reason to believe, that the small amount of carbon in steel will prevent in a great measure the wasting of the sheets by bad feed water: this is now a disputed point, however, which will in due time be practically decided without any serious clashing of engineering opinions.

The engineers who are surveying the Alleghany River have reached Warren, Pa. They express the opinion that the river can be easily made navigable, if business requires it. They find Olean 1,412 feet above tide-water, and Warren 235 feet lower. The distance from Olean to Warren is 67 miles.

The Thomas Iron Company has voluntarily increased its employees' wages at the Lock Ridge (Pa.) furnaces.

Hook and Link Motions.

Editor American Machinist:

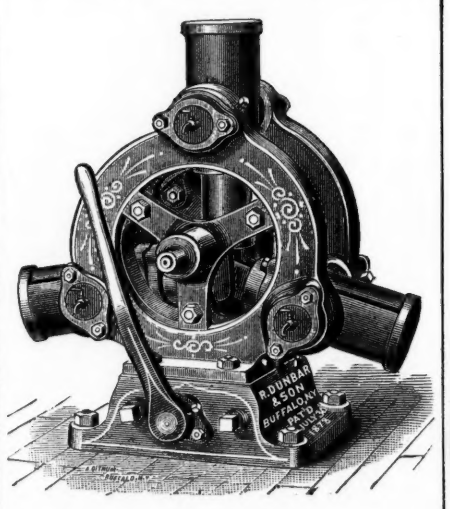
Your paper is one of the very best avenues that I know of, through which to impart useful information to all classes of mechanics, as it is the exponent of the views of some of the finest mechanical minds of the age, writers who are well versed in the progressive, and inquisitive ingenuity of the day. Nevertheless, we frequently see theories promulgated, not based on sound mechanical principles, which ought to be combated, but which frequently are not. This arises from the fact, perhaps, that those who have the ability and disposition to do so, rarely have the time, or, if they have, they regard it as an unpleasant task to be correcting errors of judgment in others. As a result, the erroneous theories are read by young mechanics, and, as they remain uncontradicted, the readers frequently settle down to the conclusion that they must be correct, or some one would controvert them, which is a great misfortune. This subject was brought to my mind very forcibly, on reading an article entitled, "Hook motion compared with the modern Link motion," which appeared in the MACHINIST of September 20th, under the signature of V. Hook, and which contained some very erroneous assertions.

A very good comparison between the hook and link motions may be found in the old jet and modern surface condensers, used on marine engines. There is undoubtedly fully as much advantage, if not more, derived from the link motion over the old hook motion, as is obtained by the surface condenser over the jet. In the first place, the assertion is not sustained by facts, that the old hook cost less than the link, which may be demonstrated as follows: The hook requires six eccentrics, with their straps, rods, and pins, four rock-shafts, four valve-stems, and four stuffing-boxes, with two reverse shafts and two levers. Besides, there are four valve faces to keep in repair, to say nothing of the first cost of fitting up. In return for the trouble and expense of putting this long train of machinery in motion, to accomplish a little thing, we get a tolerably good valve motion, and a very poor cut-off, one that is badly adapted to fine and economical working, because it is well known, that all positive or independent cut-offs have proved defective, and have been abandoned by those who have had the best opportunity of demonstrating their defects by experiment, prominent among whom is the United States Navy Department. In the trials between the United States Steamer Algonquin and Winooski, in 1864, the Winooski, which was fitted up with the ordinary link, ran more miles, and attained a higher speed with 20 per cent. less fuel than the Algonquin, which had an independent or riding cut-off, such as V. Hook speaks of. Since this conclusive experiment, the link has been adopted by the United States Government, and by all practical mechanics, on all classes of steam engines which require a reversing and cut-off valve gear.

In relation to first cost, and cost of maintenance, it is safe to say that the hook motion will cost more for repairs in six months than the link in eighteen; besides, the first cost of the link, as compared with that of the hook, is greatly in favor of the former. Link-blocks frequently run constantly for seven years, and then have only $\frac{1}{32}$d of an inch play, which can be taken up at an expense not exceeding $4.00, while it would take a good practical machinist one week to take up the lost motion in the hook arrangement, even if he only replaced the steel jibs on the jaws of the hook. On a locomotive using the link-motion, there are four eccentrics with their rods, two links, two rock-shafts, two valves, and valve-rods, two stuffing-boxes, one reverse shaft and lever, and two valve faces to keep in order. When at full stroke the link motion is as good as the hook possibly can be, considering all its bearings, while, as a cut off, it is immensely superior, as the lead is increased as the travel of the valve is decreased, or, in other words, as the link is lifted towards the center, and the supply of steam cut off at an earlier part of the stroke. This increased lead is a positive advantage, as it serves as a cushion to the piston, when its motion is rapid, which is generally the case with locomotives.

It may be claimed by some, that cutting off by the link has a tendency to affect the exhaust, but it does not do so to any injurious extent, for the latter opening of the exhaust is a positive advantage, because it counteracts, or acts as a cushion on the other end of the piston, balancing the resistance due to the early admission of the steam at the other end, before the engine has reached the end of the stroke. If two engines, one fitted with the link, the other with the hook-motion and the independent cut-off, were—working with the same amount of cut-off—if they were moving at a slow rate of speed, and "pulling to their utmost capacity," perhaps there would be a slight difference in favor of the hook motion; but these conditions do not often occur, as when an engine is running slowly the link is generally in full gear, and only when in rapid motion the cut-off is used. Under these latter circumstances, the link, as a cut-off, has no equal; but aside from all this, what would we do with the hook motion on double-ended locomotives, which number at least $\frac{1}{3}$rd of those built now, and which are required to run backwards, with the same facility, as they run ahead? In such cases, of what use is the old hook motion?

The ease and facility with which the link may be handled is another very important feature in favor of it, while the unfortunate engineer, that would handle a modern freight locomotive with the hook motion, would have to brace himself like a pugilist, and spread himself like a stump orator. He would not



require to practice with the dumb-bells to develop his muscle. As he has not only to handle his engine at full stroke, but also to manipulate the cut-off, this difficulty is very much increased in the case of a newly packed engine. Even small engines, such as were built when the hook-motion was used, would be found rather harder to reverse, than one using link motion, on account of the greater number of bearing surfaces to be moved, and the peculiar way in which the hook is forced down to move the rock-shaft pin ahead or backwards.

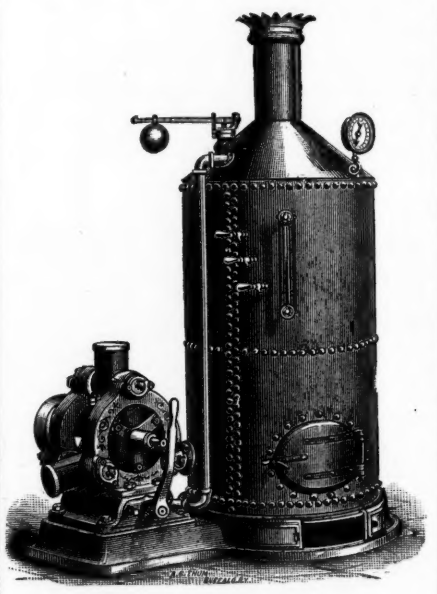
With the link both these processes are done at once, and a more direct leverage given to overcome the resistance of valve stems, etc. The incline of the face of the link is more gradual, also, than the face of the hook, and consequently more powerful. As applied to the large engines of the present day, the hook motion would increase friction, and be more difficult to reverse. The link is a splendid mechanical conception, and one of the greatest improvements that has ever been made in the locomotive or marine engine, while the hook motion, like the old throttle valve on the stationary engine, is a relic of barbarism.

STEPHEN ROPER.

The Hub says:—Australia—that Mecca of American hopes and aspirations—took nearly $7000 worth of American carriage goods during the month of September, being an increase of $4000. If carriages, why not engines and machine tools?

Wooden Boxes for Machinery.

Where slow motion only is required, or where machinery works in water, there is no other kind of box better than one of wood. The wood best fitted for this use is the roots of hard maples or yellow birch. The grain of these roots is twisted, the fibres are tough, and if the grain is placed endwise to the bearing, the resistance to wear will be found greater than that of metal boxes, for driving shafts for horse powers, threshers, fodder-cutters, pumps and other machinery where the motion is not over two hundred and fifty or three hundred revolutions in a minute. Where the motion is greater, wooden boxes lined with Babbitt metal may still be used; so that for any purpose whatever, in an emergency or for regular use, a supply of well-selected and prepared wooden boxes might be kept on hand, for whatever machinery is used out of easy reach of a foundry or machine shop. The timber should be selected for its gnarled arrangement of fibres, and seasoned slowly under cover, but in an airy place. It should then be sawed into squared blocks of the proper size for different uses, and steeped in crude petroleum or sperm oil, until thoroughly saturated. The blocks may then be put away for use, in a dry place, or kept in the tool-chest. The blocks are first roughly sawed out, leaving the trimming to be done afterward. The hole is bored of the proper size for the shaft, being centered truly and bored from each end, leaving it a little smaller than



the shaft for a tight fit. When this has been done, the block can be oiled and put away. When finally prepared for use, the block is squared up truly, and sawed exactly through the center of the shaft-hole, and is then sand-papered to fit its place. As the boxes wear, the inner surface is dressed by planing, or rubbing upon a sheet of sandpaper until the bearings are again accurately adjusted. All this may be done very rapidly by a farmer or his boy who can use tools. For boxes for water-wheel journals, and also for steps to turbine wheels, where the work is done under water, there is nothing better than wood of the kinds mentioned, and the wear of iron upon wood, or of wood upon wood, is much less than that of iron upon iron or upon brass. The best lubricator for wooden boxes—excepting in water, when no other is required—is tallow and black-lead or black-lead alone; when machine oil is used, black-lead should always be mixed with it.

Tri-Cylinder Engine.

An engine with three cylinders, working a common crank, is not a new idea, though there are few of the kind in use on this side of the Atlantic. The Gardner Tri-Cylinder Engine, shown in the two illustrations on this page (in one of them connected with a boiler ready for use), is a novelty lately offered to engineers by R. Dunbar & Son, Buffalo, N.Y. It occupies a very small space for the power it is calculated to exert. It can be used in almost any position—inverted, inclined, or upright. It is adapted to use as a hanger to drive a shaft directly, thus dispensing with a driving belt and pulleys. We lately noticed one of these engines running at a very high speed. This is claimed to be a special advantage, enabling it to be coupled directly to any desired machinery. Each engine is fitted to gauge, and any part can be replaced readily if necessary. These engines are claimed to be economical in using steam, strong, safe, and suited for any and all industrial purposes.

Compressed Air.

BY JOHN FISH, M. E.

The use of compressed air as a motor is of quite recent date, scarcely going back further in time than about thirty years. It was used first practically at the Mount Cenis Tunnel to work the rock drilling machinery in driving that tunnel; it was also used by Burleigh to drive rock drills in the Hoosic Tunnel; and since then considerable thought and attention have been bestowed not only upon the air, as used upon the different kinds of engines it has been applied to, but also upon the machinery constructed for compressing the air.

The great difficulties that engineers had to contend with in their first efforts to compress air, and afterwards to use it, were that in compressing it an amount of heat was developed, corresponding to the degree of tension or pressure of the air compressed; and also the low temperature developed when any attempt was made to work the air expansively, so as to use it economically. These difficulties seemed to act as a bar to its general use as a motor, except in such places where steam would be inadmissible and water could not be got.

The first difficulty, namely, the development of heat, was met by some engineers by injecting a spray of water into the compressing cylinder, and there, by reducing the temperature of the air to a temperature somewhat above that of the injected water. This device met the difficulty of reducing the temperature of the air, but was objected to by some that it left the air saturated with moisture, and that when the air was expanded against a resistance—that is, doing work—it was more likely to deposit ice in the narrow passages of the cylinder and thereby prevent its successful working. Other engineers cooled the air, heated by compression, by radiation: making a water jacket around the compressing cylinder, and even introducing water through the piston rod into the piston, which was cast hollow to receive the water that circulated through it. Both classes of machines have worked with a fair measure of success on rock drills and steam pumps, when the air has been allowed to follow full stroke; but when any attempt has been made to use the cool compressed air expansively it has always resulted in producing such a low temperature that the air passages have been choked with ice. This difficulty has been overcome by a French engineer by passing the compressed air, after being cooled, through water in a receiver to a temperature due to about 100 pounds pressure on the square inch. By passing the air through the hot water it takes up both heat and moisture sufficient to increase the efficiency of air to about 80 per cent.

Lewis, Oliver & Phillips, Pittsburgh, granted the request of the laborers in their Southside mills for an advance of ten per cent. in wages.

THE SANITARY ENGINEER offers a reward of $500 for the best plan of a model school-house. Our small boy will contest for that prize. His working model is not yet ready, but we may state that his idea of a model school-house is one in which the teacher never licks; where recess comes five times of a morning, vacation every other week, and examination never; where all studies are elective, and chewing gum is insisted upon; where there is co-education of the sexes, provided the girls are pretty, and where there is no punishment for a fellow, save sending him to sit by the girl to whom he was caught passing notes.—*Albany Journal.*

Machinery Industries of the Pacific Slope.

Editor American Machinist:

DEAR SIR—It may be of interest to the readers of your practical journal to learn a little about the manufacturing industries of this (to many patrons of your advertising columns) far-distant state. I have no doubt it will be particularly interesting for them to learn that in no remote day nearly all the heavy and light machinery, such as at present used in the Pacific States, will be manufactured here in San Francisco, with the exception of a few special tools.

At present over two-thirds of all the heavy machinery, such as enumerated in the following advertisement, is made here:

"A, B & C, Manufacturers of Marine Engines and Boilers—Propeller engines, either high pressure or compound, stern or side wheel engines; Mining Machinery—Hoisting engines and works, cages, ore buckets, ore cars, pumping engines and pumps, water buckets, pump columns, air compressors, air receivers, air pipes; Mill Machinery—Batteries for dry or wet crushing, amalgamating pans, settlers, furnaces, retorts, concentrators, ore feeders, rock breakers, furnaces for reducing ores, water jackets, &c.; Sugar Machinery —Crushing rolls, clarifiers, vacuum pans, air pumps, concentrators, bag filters, charcoal filters, blow-up tanks, coolers and receiving tanks; Miscellaneous Machinery—Flour mill machinery, saw mill engines and boilers, dredging machinery, oil well retorts, powder mill machinery, water wheels; Engines and Boilers of all kinds, either for use on steamboats or for use on land; water pipe, pump or air column, fish tanks or salmon canneries of every description."

This is one of many establishments of the kind, each varying from the other in some special lines, yet all manufacturing some one of the above enumerated articles.

When the capitalists of this state begin to realize the fact that the development of coal and iron mines, the encouragement of farming, mechanical and manufacturing industries are of more real, lasting benefit to the state, and more profitable to the people themselves, than all the gold and silver mines yet discovered, then, and not until then, will the state enter upon a permanent road to prosperity. As it is at present, one-half of the men and women of this city and state live upon wild, reckless speculation, and gambling in mines and mining stocks that never had, nor ever will have, any real, fixed value; neglecting or rejecting honest labor, which is the source of all wealth. Yet, in spite of all these speculative tendencies of part of our community, there are enough far-seeing, active and industrious persons engaged in developing the resources of this state, by legitimate mining, manufacturing and agriculture, with sufficient capital to aid them, to not only produce nearly everything required for home consumption, but to successfully compete with the Eastern States for the trade, not only of the Pacific States, but of China, Australia, Sandwich Islands, Mexico, and South America. The most visible evidence of this fact I have seen at the recent exhibit of California's products and manufactures at the Mechanics' Pavilion in this city. The Fair opened Aug. 5th and closed Sept. 15th.

The building where these exhibitions are held is situated on Eighth street, extending from Market to Mission street, with a front on both these streets. It is in the very center of the city and cannot be surpassed for convenience and accessibility. The building makes no more pretension to architectural style or ornamentation externally than a sectional dock, yet the interior arrangements are well adapted for the purpose intended, while the classification and arrangement of the articles exhibited reflect great credit on the gentleman who superintends it. The space under roof exceeds 180,000 square feet, or about 4½ acres, exclusive of the horticultural garden, which occupies 24,500 square feet additional.

This horticultural garden is a most excellent feature as an addition to a mechanics' fair, as it affords a favorite and pleasant retreat from the noise and bustle of the main building; but it is only practicable in this genial climate, where the flowers are in bloom and the grass remains green all the year round.

A person who has not visited this enterprising city, or is familiar with the energetic go-ahead qualities of its people, finds it hard to realize the extent to which every branch of manufacturing industry has been pushed in such a short space of time. If a person wishes to investigate the condition of the industries of a city or state, and his time to do so is limited, the most sure and economical plan he can adopt is to visit a mechanics' fair if one is open. There he will see the "king bees," as the drones have nothing to exhibit. Or let him, in the absence of the fair, scan the advertising colums of a live newspaper, with the fact in view that those who do not advertise are men who have either *retired from business* or business has *retired from them.*

I had a desire to learn what was being manufactured here, and with that object in view, I paid many visits to the Mechanics' Pavilion while the fair was in progress. These exhibitions, like all others of the kind, are organized with a view of making every dollar and cent possible out of them, consequently a large number of articles are exhibited, such as can be seen every day in any house-furnishing or grocery store. Yet the managers of this Institute are justified in admitting such wares, with a view to showing the progress of this state, as they all are of home manufacture and should receive every encouragement.

The managers are very liberal and accommodating to exhibitors. No entrance fees are charged; water, gas and power are furnished, and connections made, free of charge.

The general display of goods in the main aisles are such as one sees in the American Institute Fairs in New York, or the fairs of any other large city, with the exception of a few specialties of California manufacture. I will merely mention a few of the machinery displays and kindred articles exhibited, all of home manufacture, which would most interest your readers, without a lengthy description:

Wire and wire-worked wares; wire rope for mines and cable railroads; lead pipe, sheet lead, shot, etc.; terra-cotta, chimneys and chimney caps, vases, figures, etc., far superior to Eastern ware in quality, style and finish; vitrified sewer pipe, equal to the best Scotch pipe, in depth of glaze and toughness; fire brick and tiles of very good quality; ship's lamps, mining lamps, spun brass and copper goods, equal to Eastern goods.

The first in order in the machinery department is the Pacific Saw Manufacturing Company's exhibit of circular, cross-cut and all other kinds of saws. The circular saws, from the largest to the smallest, were placed against the side of the building and made to revolve in every direction, which produced a very fine effect. This display of saws was equal to any exhibited at the Centennial, and reflects great credit on the company making the exhibit. Agents for Hoe, the American, and other Eastern saw manufacturers also exhibited circular saws.

Fire-proof metallic laths, with a simple but ingenious machine to make them, were exhibited—in operation.

W. T. Garratt's displays of brass and iron work, large globe valves, cocks and gates for steam, gas and water works, steam whistles, gauges and gauge cocks, were of the highest finish. It is not the finished work that displays the skill of the metal worker to advantage, as putty, paint and polish hide many defects. To produce castings of a uniform quality and color, so that, when they leave the sand, they require the least possible labor to finish them—especially cored work, which has to be finished—should be the aim of every good moulder. But few succeed in reaching the best possible result to be obtained.

In Garratt's exhibit of cored brass castings these requirements were fully met. Cleaner castings, and more uniform in color, I have never seen, and I have had 25 years' experience in that line. Hooker's steam pumps, and other pumps, were exhibited by the same firm. Heald, Sisco & Co.'s centrifugal pumps were exhibited by Parke & Lacy.

I will have to make special mention of the Pacific Rolling Mill Co. exhibit, as I regard it as the most important of all. Railroad and merchant iron, rolled beams, angle, channel and T-iron, bridge and machine bolts, lag screws, nuts, washers, etc.; steamboat shafts, cranks, pistons, connecting rods, etc., made up the display. I examined the quality of iron in the finished shaftings, and other articles, and found them without a surface blemish. So close was the grain that the finished surface looked like steel. This is, probably, owing to the fact that a great quantity of scrap iron is used.

It would take up too much of your valuable space to make particular mention of all; so I will simply designate the names of firms in your special line:

Union Iron Works, Prescott, Scott & Co.; Ætna Iron Works; Phelps Manufacturing Co., wharf, bridge and railroad bolts, railroad trestle and car frames; Golden State and Miners' Iron Works; California Machine Works; Hendy Machine Works, engines and boilers; Pacific Iron Works, engines, boilers, etc.; Western Iron Works, architectural work; Main St. Iron Works, stationary and marine engines; The Risdon Iron and Locomotive Works; Fulton Iron Works, general machinery; Hawkins & Cantrell, hoisting

and portable engines, and mining machinery of all kinds; California Brass Foundry; Berry & Place, mill and mining machinery of all kinds; Thomson & Evans, engineers and machinists.

There are, at least, fifty other machine shops and model shops, all doing a good trade, and nearly all having their products on exhibition at this fair.

F. A. Robbins, formerly with Bliss & Williams, of Brooklyn, N. Y., made a very creditable display of presses and dies, jewelers' rollers, and the like.

I have omitted to mention agents for Eastern manufacturers, of which there are many here, as I desire your readers should see to what extent iron machinery and other industries were being developed here.

At some future time, I may be able to give you the number of men employed, the wages received, the cost of living, and other interesting facts.

Yours respectfully,
THOMAS F. HAGERTY,
4 Henrietta Square, San Francisco.

Talks.

BY WM. LEE CHURCH.

There is a friend of mine who is the inventor and patentee of a peculiarly successful governor. It isn't amiss to say, too, that while he is an inventor of the highest order, with a head fairly overrun with ideas, unlike his less well-balanced brethren, he believes in making his brains feed his stomach and clothe his babies. In short, he knows a dollar when he sees it; so he don't go capering about after every wild notion he comes across, but, having cornered a good thing, he hangs to it till it is perfected and proved, and manufactured, and fairly on the market, in good hands, and ticking off the dollars for him while he is asleep. *Then* he goes for the next thing with an appetite. You needn't do his way if you don't want to.

Well, as I said, he has got up the most thorough-paced governor that I know of. And, by the way, everything that he gets up *always is* thorough-paced. And why? Because he don't commence to whittle before he commences to think. No; he goes first and sets himself down before the machine he is going to improve (and did you ever think that not one invention in fifty thousand is, out and-out, brand new, but that, of the myriad patents on record, each one is merely an *improvement* on its ancestors—same as you and I are?) Well, he takes his machine in hand, and looks carefully to find what it does *right*, in the light of a knowledge of what it ought to do. He blocks out the broad principles of the thing. He *insists* on those principles, and travels steadily from cause to effect. His motto is: "What? Why? How?" If he strikes a snag, he don't dodge around it, but he climbs over it, and crawls through it, and digs under it, until he understands the snag a little better than he does the straight work. He believes in *reductio ad absurdum*. His successes are fortunate, but his failures are blessings. He is convinced that there is a reason for everything. And he is not satisfied because his contrivance performs, and corrects, and registers, and knocks off when done, but it must do it automatically, and with only three pieces and one motion. He don't sacrifice the unity of the whole machine to some little do-funny jimcrack in it that happens to be ingenious, but he prunes his own work with a merciless hand, and abhors a rut and the devil. That's the way he came to get up such a good governor.

The first one he built was an ideal one—he built it in his head. He got out his drawing board, to be sure, and his T square, and shaved a nice point on his H. H. Faber. Then he drew a center line the whole length of the sheet, and then he began to stare at the wall and think. And then the "whyness of the thusness" began to appear to him, and the principles of the thing began to get themselves together in order on that wall, and clothe themselves in brass, and iron, and wood, and the thing began to move and turn round, as was appointed to it to do, and it got stuck and worked the wrong way, and heat expanded it, and grit wore it, and oil gummed it up—all on the wall—and he altered it, and adjusted it, and rubbed out and began over again, until, just as he smelt the buckwheat cakes for breakfast, he hollered, "Eureka!"—no, he didn't holler, not being enthusiastic; he remarked—and went to bed. And all this while he didn't have a thing to show for it on the paper but the center line with no center to go through; but the thing worked beautifully then and thereafter. Probably I should have commenced on the same job by making the pattern and turning up the shaft the first thing, but as the experiments and failures would cost me $1,200, where they cost him $7—mine being done in the flesh and his on the wall—the necessities of spring bonnets in the household compelled me to let go, and so my friend got it up, and the dollar, too, after all.

Well, this governor of his is about right, and no mistake. It is full of "points," and will do more than any governor—I am not speaking politically—ought to be expected to do. But one thing about it was curious. The curious point was a good point, mind you, but B. (that's the friend I am speaking of), is not satisfied with blundering into a good thing and thanking Providence, but he wants to know how it came to do so. It would be just the same if he happened to wake up some morning on the happy side of the Pearly Gates, he would want to go back and look up the combination lock before he went up the Golden Street. Well, this was it: You see the governor could be used with a valve as a throttling governor, or to adjust the dies for an automatic. What B. was aiming at all this while was simply a governor to *govern* closely and surely and safely, but he never thought of its having much effect on the *economy* one way or another. Now, there are lots of good governors in the market, and B. was naturally pretty delighted to find that when he pulled them off and put on his, that he not only governed finer, which he expected, but that he burned from ten to thirty per cent. less coal (fact), which he didn't expect at all. You and I would have been perfectly satisfied with ourselves and the result, and have had some oysters right away; but not B. The how-come-you-so was the canker in the rose. So he worried over it a month and couldn't make it out, and came over to me with it, and although I wasn't so much interested, the thing bothered me off and on all summer, and I began to lose my patience, till one day I happened to drop my indicator on an engine, and there stood the whole thing revealed as plain as you please. I guess, on the whole, I will stop talking for this time, and meanwhile you might be thinking up what the reason was.

The Mechanism of Burglary.

In a recent issue we published an article by Park Benjamin, Ph. D., entitled "Safes and Safe Breaking," and herewith we present illustrations of some of the tools that burglars are in the habit of using to open safes and buildings. Much has been said about the mechanical skill of burglars, but, as a rule, their proficiency in mechanics has been greatly overestimated. No first-class mechanic would think of using such an extensive kit of tools as either of those here shown, for a single burglarious operation. Each of these two pages exhibits a set of tools, as captured after the robbery of a bank, and, from the number and bulk of the tools taken, it is plain that the labor of several men must have been needed to carry and manipulate such a collection, suggesting the outfit of a small machine shop.

The greater portion of these tools were, presumably, manufactured in New York City, but in what shop, by whom, or under what conditions, remains, as yet, a secret. Certainly a considerable degree of skill, and some facilities, were required for their construction, although we do not find the advertisement of the makers displayed in any newspaper that we are familiar with.

The whole subject forms a fitting commentary upon the workings of the system of educating convicts in the mechanic arts and, afterward, turning them loose upon the community as finished tool makers and cracksmen. The wrong is multiplied if, while they are acquiring this mechanical skill, their labor is farmed out, at 40 cents a day, to the utter prostration and ruin of every branch of business in which they are employed, as occurs under the prison labor contract system, now so much in vogue in the large cities and States throughout this country.

We are indebted to Messrs. Herring & Co., safe manufacturers of this city, for the use of the engravings shown.

The central figure, in the larger cut, represents an ingenious form of jack-screw, with a ratchet attachment, to work either way, used for the purpose of forcing a wedge, such as the one shown at the top of the jack, into the door of a vault or safe. It can be turned in any position for use, as circumstances may require. The opening thus made by the wedge, which forms the beginning of a safe-breaking operation, is utilized by the introduction of a jimmy, the various forms of which are shown in the cuts marked 2, some of these being made short, with a thread cut on the end, in order that levers of different lengths may be attached, to increase or diminish power.

The figure marked 3, in the cut, represents a form of extension drill, consisting of a long shank, with a chuck at the end, for the purpose of holding drills of different varieties and sizes.

Fig. 4 represents a peculiar form of steel wedge, used where great power is required in bursting doors, etc.

Figs. 5 and 16 represent tools, whose use does not appear to be very well understood by non-burglarious observers, while figure 6 is too well known to require any description.

Fig. 7 represents a single-ended box wrench, which may be used in turning a tap or reamer, as occasion may require.

Fig. 8 represents the ordinary form of breast drill or stock, used where light drilling is required.

Fig. 9 represents a sledge hammer, 10 the common wood auger, 13 a bit brace, 14 a monkey wrench, 15 a powder can, 17 spirit lamps, 20 brad awls (used for fastening screens or blankets at the windows), 21 represents a wood chisel and gouge, 22 files, all of which are of the ordinary patterns.

Fig. 11 represents a peculiar form of funnel, consisting of a tin can with a rubber tube attached, which is used for the purpose of pouring powder into locks and other cavities after drilling.

Fig. 12 represents a false key, which was used for the purpose of opening the door of the bank robbed.

Fig. 18 represents a peculiar form of chisel or drift; also three common drills for use in a ratchet, while fig. 19 represents a coil of safety fuse for igniting powder.

Figs. 23 and 24 represent pieces which were taken out of the partition and vault respectively.

The tools shown in the cut on page 7 represent an air-pump and other appliances, the latter being mainly similar to those already described. The air-pump is used to exhaust the air from a safe. The two oblong caps connected with the tubes are placed over the joints of the safe door at the hinges, all other parts being air tight. A reservoir containing powder is connected with the pipe between the two caps, so that when the air is exhausted from the interior of the safe, a communication is opened through the reservoir with the outside air, and the air rushing in carries the powder with it into the safe. A fuse is then inserted and the door blown open.

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No Mystery in Boiler Explosions.

Recent boiler explosions, accompanied by loss of life, especially those so frequently occurring on tug boats and river steamers, would seem to call for a more searching public inquiry into the causes that lead to these deplorable disasters. Almost any evil that threatens the public safety (except those political) can be either reduced or obliterated if popular attention becomes concentrated upon it. If the responsibility of boiler explosions could be fastened where it belongs we would hear much less about such accidents. Unfortunately, the efforts of many of those who are believed to be best qualified to point out clearly the real causes of explosions are seemingly directed to mystifying the whole subject, and preventing needed action by reason of the confusion they bring about. As people scarcely ever act without a prime motive, it is but fair to assume that these individuals always have an interest to serve in deepening the mystery. So-called experts may get their expressions of doubt and perplexity into print after every appalling boiler explosion, in such a way as to create a belief in the minds of many people, who are not mechanics, of the existence of some unknown gas or some remarkable ethereal substance (like the ancient phlogiston) that cuts up antics in boilers when under steam, and forms the active principle of every explosion. This mystification serves two purposes: it diverts attention from the real responsibility, and it aids to bring about an "investigation" profitable to the experts. If an old boiler has been patched time and again, had its interior frescoed with hard scale, and its fire sheets burned, yet is made to do duty under full pressure of steam, its explosion is likely to bring out the manifestoes of several "experts," each couched in the most abstruse and confusing terms, aiming to show that there existed some hidden cause not dreamed of by average intelligent mortals.

If a new boiler blows up shortly after being inspected and passed by Government officials, as was recently the case on a steam tug near this city, the promoters of mysterious theories might be supposed to keep silent and let the facts come to light without offering any obstructions; but no such happy course is permitted. The occult and unharnessed "forces" are again paraded to awe the seekers after defects in construction and management. The exercise of good common sense in connection with known mechanical phenomena will, in every instance, dispel the imaginary clouds that hover over the wreck of shattered steam generators, and, if the ordinary facts are known, lead to correct conclusions, placing the blame where it belongs. It is time the intelligent public were disabused of the notions that the *ipse dixit* of a professional expert, often serving nothing besides his own interest, should weigh more in the balance than the combined testimony of experienced engineers and skilled mechanics, who have no interest in bringing an unjust accusation.

Let boiler explosions be treated the same as railroad accidents, and, in the light of accumulated facts, single out and hold up to open condemnation—if punishment cannot be meted out—the authors of the calamity.

The Metric System Domestically Considered.

The recent establishment of the cental system in most of our important grain aud produce exchanges seems likely, at this writing, to favor the proposed introduction of the metric system of weights and measures in this country, upon the principle that one change naturally paves the way for another. Yet even the most ardent advocate of the projected reform must concede the advantages which will ultimately follow the free discussion of the question in all its phases, favorable and otherwise. We have, therefore, thought it proper to state one aspect of the case for the common benefit.

Every man whose opinions are worth considering, or whose vote (upon any non-political subject) is worth counting, must admit at the first asking, that, when the feminine portion of our body politic makes up its mind decisively upon any subject under discussion, the arguments upon the other side of the question must needs be very convincing to stand any show of success at all. There are some extremely unmarried male persons who would doubtless be base enough to suggest in this connection the cogency of such arguments as are usually classed under the general heading of fall bonnets, seal sacques, muffs, candy, &c., but the right thinking portion of the male world will find a freezing silence the best and most suitable reply to insinuations of this character. The fact remains, however, so far as the metric system of weights and measures is concerned, that, before the system can be successfully introduced, wholesale prejudices of the very strongest character among the female members of society must first be met and overcome.

The fair sex in this country may, perhaps, fairly be divided into three classes, viz., those who are married, those who expect to be married sometime, and those who merely want to be married. Now, daily observation satisfies us that almost the entire civilized female world belongs to one of the first two grand divisions named above, the number of the third class being very small, indeed, and mainly confined to a few impracticables.

Since the recent decisions of several eminent judges in the courts of public opinion, that household work is not necessarily degrading, or martyrizing (except in extreme cases), it is well known that numbers of estimable housewives have developed an unlooked for degree of skill in cooking, baking, &c., and numerous young ladies have manifested a healthy ambition to be something more than mere dolls and butterflies, and have acquired an astonishing proficiency in household pursuits, which were formerly either tabooed or ignored. Now every cook book ever compiled, and most that are likely to be promulgated, base their formulas upon spoonfuls of this and handfuls of that, and teacupfuls or bowlfuls of the other ingredient. This is too well understood to be seriously disputed. Now, does anybody suppose that impulsive, inflexible womanhood is going to readily adopt such ungraceful and awkward designations as milliliters, centimeters, and the like, without a struggle? Does any sane man suppose that a pudding containing 1893 milliliters of tapioca, for instance, instead of a reasonable number of spoonfuls or teacupfuls, as the case may be, could possibly taste as well, or commend itself to the best instincts of the female heart? Let such bold supposers try it and see!

Then, too, the system of weights is, if possible, a still more important item in household economy. Consider the feelings of a newly-made wife and mistress of a French flat, conducted on the American plan, if rudely and suddenly called upon to purvey, for culinary purposes, 4.1837 kilogrammes of beefsteak, or sugar, or rice, or anything, instead of the familiar and time-honored *pounds* of her girlhood. Or, more forcibly still, consider the pitiable sufferings of a young mother, for example, if compelled, by a heartless and inexorable law, to telegraph to the absent husband and father that he had just become part proprietor of a 4.082 kilogramme boy, or a 3.175 kilogramme girl! But comparisons of this sort are odious, and will not be tolerated for an instant by any well-regulated feminine mind, without argument of the most convincing character. Similar illustrations might be multiplied, but the above should suffice to indicate to the advocates of the proposed reform the line of opposition that must be overcome before the metric system can be successfully introduced in this country.

On our first page this week Chordal relates his experience with Wyckoff in making fits and close measurements in a machine shop. Wyckoff is the type of a large number of machinists who have been in the business many years, yet are difficult to convince that the use of standard sizing tools is preferable to filing and scraping, and making trial after trial to secure an accurate fit in the old-fashioned way. When a mechanic of this self-sufficient class gets cornered by a philosopher like Chordal, and is obliged to admit that there are finer, and more accurate and less expensive ways of doing shop work than he has ever followed, there is hope of that man's future progress.

Manual School Instruction.

One of the most favorable tendencies of recent methods of instruction is towards manual, as well as mental practice. Students of technical institutions are being instructed to use hands, as well as heads; to combine the practical with the theoretical. This tendency, which we would naturally expect to find in polytechnic institutions, has even developed itself in the regular literary colleges and universities.

The Washington University of St. Louis, which has had, for some time past, connected with it a polytechnic school, is now erecting a suitable building for a workshop, in which to teach, practically, the various branches of machine work. The importance of training young men in the methods of using the different tools and appliances applicable to workshop manipulation cannot be over-estimated. Ours is a practical age. The services of a man, in ordinary business pursuits, is not valued according to his acquisition of ancient languages and modern classical literature, but according to his ability to do that which increases material wealth. There is but ltttle demand for any addition to the professional classes, but to the skilled artisan an inviting prospect presents itself. The sooner our higher institutions of learning recognize this fact, the more worthy of generous support will they become. The polytechnic school of the Washington University provides for a course in mechanical engineering, civil engineering, and mining, either of which students can select. In manual training, students are drilled in exercises giving them familiarity in the use of chisel and gouge, as applied to pattern work; next, in wood turning and pattern making; then in chipping and filing metals, and, finally, in blacksmithing and machine tool work. Thus practical application is made of the theoretical principles taught in the lecture and class rooms, and the student leaves school with a practical knowledge of work which it would take him years to acquire in the actual practice of engineering.

The introduction of such schools, in connection with our colleges and universities throughout this country, is a movement urgently called for by the advancing spirit of our times.

Permanence in Industrial Exhibitions.

Every one who has observed closely the course of things at industrial exhibitions is enabled to mark the successive stages of weakness and decay that seem inseparably associated with the very idea of a regular exhibition. More than one noted exhibition, that we might name, originally started as a real and almost universal display, has dwindled yearly into an affair combining the characteristics of a country fair under roof, with the catch-penny attractions of a huge collection of booths for the retailing of notions and curiosities.

After the first exciting and valuable season, apathy seems to seize upon managers and exhibitors alike. Often the former attempt to use the show for their own private purposes. Each year a new installment of disappointed or dissatisfied exhibitors sloughs off, until, for the purpose of filling up the otherwise empty spaces, the managers are compelled to disregard all efforts looking toward completeness and representative character, and peddle out to anybody who will take them, for any sort of relevant or irrelevant purpose, the spaces that should be put to practical and instructive use. And so the disintegrating process goes on, and year by year the fair declines in interest and value. In such cases there can be but one remedy and that is the heroic one of an entire change

in managers, as an essential preliminary to a change in management. Even if the new managers are no better, personally, than the old, the public require a change, presumably acting upon the adage that "a new broom sweeps clean."

The lively discussion now in progress in Philadelphia over the question of retaining or pulling down the buildings, which for the past three years have been used for the purposes of a permanent display, open all the year round, is an illustration of this topic from another point of view. The difficulty in this case seems largely to be that crowds of people cannot be kept perpetually thronging the doors of an exhibition of this kind, whatever the intrinsic merits of the display, and crowds seem to be a necessary ingredient of a successful show. This is a work-a-day world, and the public tires of perpetual brass bands, and gala sights and sounds. Museums live, but exhibitions languish, and the cause is not far to seek.

Upon another page will be found a communication from an observant mechanical engineer, Mr. Thomas F. Hagerty, regarding machinery manufacturing on the Pacific coast, with especial reference to the successful Mechanics' Fair in San Francisco, which closed recently. The mechanical doings and prospects of California are well treated in this letter, and will be read with interest by workmen as well as manufacturers.

We recently received an invitation to attend a meeting of the Microscopical Society, the chief feature of which was to be a discussion upon "The Mechanism of Insect Stings." Being unable to be present, some interesting facts regarding the mechanical workings of the typical suburban musquito, which would doubtless have been soothing to the feelings of all concerned, were violently suppressed. Fortunately, however, the cooler weather which we are now enjoying has rendered pointed fact and stinging sarcasm upon this subject alike unnecessary and unprofitable for several months to come.

Letters from Practical Men.

Editor American Machinist:

Your journal, issue of November 1st, contains an editorial article, "The Education Young Men Need," which is good enough in its way, and as an incentive to a right course to some vacillator upon a future career is of value; but I must object to the insinuation that clerks are such because of preference for lily hands and aversion to grimy occupations. Many articles of like tenor may be seen from time to time, all delighting to stab or hammer the poor devil of a clerk, and I am afraid he has but a poor show. I venture to assert that nine-tenths of those who are clerks are not so by deliberate choice, but become such from necessity. Fatherless boys, with widowed mothers, orphans with younger brothers and sisters to help, if they have a spark of manhood in them, are not the ones to stand and deliberate what will be their best course in life; the question is, rather, how can I earn the most money to-day, for aid to my family. That is easily answered, because the errand boy, if intelligent, can command at twelve years a wage that a trade apprentice can get at sixteen, and has a speedier chance of getting more.

As in your article you generalize and speak of the worse features of the subject, so may I, and yet admit of exceptions to my defense of the clerk; for some do become clerks for the sake of the present gain from a selfish motive, and an incorrect opinion as to the relative respectability of a clerkship and a trade—but they are few. Clerks are made from those who must work at an early age. You will find very few clerks satisfied with their condition, and who would not prefer greatly the swing of the hammer to the pen if they could make the change. This discovery comes too late in life. Necessity controlled the choice, and mature age prevent a change. Another reason why more men are not mechanics is, that they are of the lighter-framed races, who are looked upon by the shop proprietors and foremen as not possessing sufficient strength to be laborers in the shop, and are thus refused opportunities which the muscular mental imbecile can secure because he is a better physical machine. What troubles the mechanical labor market is the absence of this class, early forced upon the world for a living, who, I think, acquire by the early forcing, a high grade of ability—perhaps narrow in scope, but with an acuteness and readiness of hand and head that would be exceedingly valuable to a mechanic. The early age at which such start enables one, as a boy, to acquire information which a workmen would never dream of telling an apprentice. The small boy will get it to satisify a curiosity, and he will store it for use. Now the aim of my letter is to suggest that, if proprietors will provide work for such boys, by making a long apprenticeship of say six to eight years, laying out for the youngsters, at the start, some compulsory education, letting them run errands, sort screws, clean castings—by all means, if he is to be a moulder, make him clean castings first, and do many odd things that will in no sense "run a man out of a job," but will enable the boy to learn many things and be fully prepared for tool handling when his size and strength makes him ready for it. Make some such arrangement and the mechanic trades will not depend on brute strength on one side and offspring of luxurous homes on the other, who become tradesmen after becoming C. E's or M. E's at some technological school, for their replenishing. The latter class produces some good men, but they rarely have the application which a boy acquires who has been compelled to struggle, and because of the principle "If you want to make a business man out of him, don't send him to college."

C. F. T.

Editor American Machinist:

I would like to suggest through your columns that V. Hook's plan for squaring locomotive frames was in practice thirty years ago, and is as unreliable and complicated as the old discarded V. Hook itself. The modern way of fitting up locomotive frames and cylinders are so much more perfect, that V. Hook's plan would not be countenanced in any of our first-class shops that I am acquainted with. Locomotive frames are now fitted up complete, driving boxes fitted and bored to fit the axle, all holes drilled for cylinders, rocker-shaft boxes and braces, so that by simply placing the center line of cylinder marked on frame, on the center line marked on cylinder or on saddle, thereby forming a perfect rectangle between centers of driving boxes and centers of cylinders, also a perfect triangle with the center-pin which guides forward truck and forward driving wheels, without which it is not possible for the driving wheels to track square, the result of not tracking square being the cutting of the tire flanges, in some cases, to a knife-edge, and a constant danger of leaving the rails.

The days of building locomotives by scribe rule has long since past. Now-a-days all parts of a locomotive are finished by templates. Frames, cylinders, links, rocker shafts and boxes, guide bars, connecting rods, driving wheels, driving wheel boxes, excentrics and connections, cylinder heads, valve rods and valves, with every other small part are finished complete, in their respective departments, from steel templates for the different class of engines; then laid away until needed for assembling them in the erecting shop on theeighteen or twenty different classes of locomotives, and to such perfection are all these parts, that some builders can duplicate from any one plate in the boiler to the smallest screw, on receipt of order simply giving builder's number and nameing piece required, with all holes drilled ready for the bolts, and with the same preciseness as any part of a government rifle or a Waltham watch. Thirty years ago it required 1,800 days labor to construct a locomotive; now it will not exceed 1,500, and a far superior machine in every respect.

There are 16,000 locomotives in the United States, and there are over 2,800 different pieces in each, all of which will have to be renewed every ten or twelve years. Locomotives that retain their identity twenty years or more, as claimed by some roads, are something like the boy's jackknife which he had ten years, but it had had nine new handles and thirteen new blades. The present capacity of all the shops is not far from 1700 locomotives per year, and the different roads built in their own repair shops about 100 more, making 1,800 a year in all. Now, allowing 15 years as the average life of an engine, you will see that the shops can build 27,000, in the mean time showing that the present capacity of our locomotive shops need not be extended for a long time to come.

NEW YORK. B. W. HEALEY.

Business Specials.

Forty cents a line for each insertion under this head.

Brown & Sharpe M'f'g Co., Providence, R. I., keep in stock at reduced prices Patent Cutters for the teeth of gears which can be sharpened by grinding without changing their form. All wheels of same pitch cut with them will run together correctly. Send for new catalogue.

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Lathe Attachments for Milling Plane and Irregular Forms; Taps and Reamers fluted and Gears cut without removing from the lathe centers. For extended description, see AMERICAN MACHINIST, Sept. 13 and 20 issues. Send for circular to Wm. Main, Piermont, N. Y.

Tool Chests with best tools, scroll saws, wood and designs. Amateurs' and Machinists' Tools. Send for Catalogue. Tallman & McFadden, Philadelphia.

AYER & SON'S MANUAL contains more information of value to advertisers than any other publication. Sent postpaid on receipt of 25 cents. Address, N. W. Ayer & Son, Advertising Agents, Times Building, Philadelphia.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) F. E. B., Fishkill Landing, N. Y., writes: Please inform me which is the cheapest and most satisfactory way of finishing polished surfaces on engine work—by draw-filing and then finishing with sand-paper, or by filing out the tool marks and then rubbing down with the prepared emery blocks now in the market? *A.*—We would recommend the plan of draw-filing the surface with a fine file, and finish with emery paper, or cloth. We remember seeing a surface thus finished which was so finely polished that common paper would scratch it.

(2) S. A. B., Catskill, N. Y., writes: Will you please inform me how to harden Gutta-percha? *A.*-Gutta-percha may be hardened by grinding Sulphur and incorporating with the raw material, and then subjecting the same to a strong artificial heat. Much time has been wasted in experimenting in the efforts to manufacture gutta-percha into such articles as combs, etc., but the result has been far from satisfactory, for the reason that it is more brittle and also more expensive than hard rubber.

(3) A. E. R. Eaton, N. Y., writes: Will you plese inform me where I can procure the best book on the construction and workings of Hot Air Engines, also price of book? *A.*—There has been no treatise exclusively on the Hot Air Engine published as yet, but you will find the most complete treatise now extant on the subject, in "A Manual of the Steam Engine and Other Prime Movers," by W. J. M. Rankine, C. E., crown 8vo, cloth, price $5.00; to be had of any bookseller. In regard to the construction and management of each particular engine, we would advise you to get the catalogues of the different manufacturers, of which we give the names of the principal ones, viz: Delamater Iron Works, N. Y., builders of the Ericsson; Sherrill Roper Air Engine Co., and A. & F. Brown, N. Y.

(4) M., St. Louis, Mo., writes: Could you inform me how I might get an appointment as a naval cadet engineer, or who it is that examines applicants, and what qualifications are necessary? I am over sixteen years of age and have served about fifteen months at the trade. *A.*—As to the qualifications necessary, etc., we would refer you to our editorial on Kid Glove Naval Engineers, contained in our issue of Aug. 23d, 1879, also another on A Naughty-cal Affair in our issue of Sept. 20th, 1879. We would advise you to seek an appointment at some other business, as it is utterly impossible for all the cadet engineers now in the service to get appointments as engineers, as there are not enough vessels now in the whole U. S. Navy to give them all a chance. If you wish to go to sea, you should rather take the necessary steps to get a situation on some line of steamers or merchant vessel, as it will be far more satisfactory to you.

(5) O. C., Brooklyn, N. Y., writes: Will you kindly answer the following question—By what simple rule can I determine the volume of air when compressed to a certain pressure? In other words, the piston of an air compressor starts with only the resistance of the atmosphere, and I wish to determine the resistance at different parts of the stroke. *A.*—The information you desire is contained in a pamphlet published by Prof. R. H. Thurston, in 1874, entitled "Thermal and Mechanical Properties of Air and Other Permanent Gas Subjected to Compression or Expansion," and is accompanied by large scale diagrams, which you will find a necessary reference in experiments on compressed air, and shows the pressure and volume at all points of the stroke. You can learn more by a brief inspection of the diagrams and description than from a whole page of reading matter. The pamphet and diagrams may be procured from the author at the Stevens Institute, Hoboken, N. J.

MANUFACTURES

E. S. Snell & Co., of Brockton, Mass., have recently shipped an invoice of their shoe tools to Germany, and have just filled quite a large order from California.

The Northern Pacific railroad company are building a round house and machine shop at Fargo, Dacotah Territory.

Corning's new storehouse at the iron works is rapidly approaching completion. It will be ready for occupation in a few weeks. Burden will shortly place in his mill a newly patented machine for making horse shoes, designed for winter use. Employment will thus be given to an additional force of men. —*Troy Evening Standard.*

The City Council of Vincennes has resolved to purchase another steam fire-engine, one not being deemed sufficient.

The puddlers at the Fall River Iron Works, whose wages were recently advanced twenty-five cents per day, struck recently for still higher pay.

The Pullman Car Works, Detroit, Mich., employ 600 men. The capacity is 100 Pullman cars per annum. They are building a new blacksmith's shop, 45×90 feet, which will cost, with its machinery, $12,000.

Newport, Vt., is to have a new veneer mill, 80×40 feet and three stories high, New York parties furnishing the capital.

The Laconia, N. H., Car Company have a contract to build 100 box-cars for the Fitchburgh Railroad.

Work on a new shoe factory has been commenced at Dover, N. H. The structure is to be 130×48 feet.

The addition which the Hayden Co. have made to their foundry at Haydenville, Mass., cost $5,000, and the new machinery that has been added to the works is worth $10,000.

All the foundries at Weir Village, Taunton, Mass., are filled with orders. The foundry business is better than it has been for many years.

Ground has been broken for a new furniture factory by Messrs. Keller & Sturm, on the corner of Elizabeth and Fulton streets, Chicago, Ill. Power will be furnished by a 75 H. P. engine, which will operate new machinery throughout.

The John Russell Cutlery Co., Turners' Falls, Mass., are running full time, with 650 hands, and producing 3,000 dozen pieces daily.

A rather ingenious new patent, much spoken of in the press of Belguim, consists of a portable hydraulic engine, which can be used in all houses having a water supply, and may be worked in the simplest manner by a flow of water from the pipes. It can be employed as an engine to work all kinds of things, such as sewing machines, lathes, churns, coffee mills and mincing machines. It will in fact, if reports speak truly of it, be as useful in private houses as in public etablishments.

The Bodwell Granite Company, of Wayne, Me., are making a 45-foot addition to their works, the new portion to be used as a machine shop.

The Perkins Manufacturing Company of Geneva, O., has been organized for the manufacture of elevators and machinery. Capital stock $25,000 in shares of $25.

James A. Calvin has begun the foundation for an addition to his foundry at Athol, Mass., to be 40x30 feet, which will increase the capacity about three-fifths, and is considering the advisability of increasing the capacity of his foundry at Worcester. At the latter place about 60 men are employed.

It is stated that a stock company composed of New York and Philadelphia gentlemen, representing a cash capital of $250,000, have purchased the water power facilities at Willow Grove, N. J., and will immediately build factories there, with the anticipation in view that at no distant day the new railroad will be extended from Newfield to Elmer.

The Jessup & Moore Paper Company have purchased a large lot in the western part of Wilmington, Del., on which to erect extensive works for the making of paper pulp from wood. The expenditure for this operation is estimated at nearly $250,000. These works, when completed, will give permanent employment to a large number of operatives.

The Hudson Paper Car Wheel company has appointed a committee to determine upon a site for the erection of works, either at Chicago or St. Louis. The company's works are now at Hudson, N. Y., but it desires an establishment in the west, also.

The Cleveland (O.) Paper Co. have laid the foundation for a large new mill at Eight-mile Lock, south of Cleveland.

Dunbar, Hobart & Whidden contemplate making a 50 or 60 foot addition to their factory at South Abington, Mass.

The Nixdorff Chain Works of St. Louis, employ 125 men, and the chain works of Franz Krein a force of over 150 to 175 men.

Five hundred and fifty men are now employed upon the New York approaches to the East River Bridge. Ninety thousand bricks are laid daily.

The Missouri Car Wheel Company of St. Louis, Mo., will very soon have the shops for the construction of freight and coal cars completed. There will be five buildings in all. Large orders have recently been taken for box cars, which will be turned out before the 1st of January.

Business has been increasing so rapidly of late that the Chicago Screw Works have found their present quarters and machinery indequate to meet the growing demand upon them, and, consequently, are seriously meditating upon the feasibility of inserting new and improved machinery or removing to larger and more commodious quarters.

Machinists' and Engineers' Supplies.

The market this week is bare of novelties; the "boom" having choked them off. The time of manufacturers is so largely engrossed with keeping up with orders on regular goods, that less disposition is shown to experiment on new things, than in the days when novelties were required, as bait for buyers to nibble at, to induce them to buy regular goods. Then, too, election week has interfered to some extent.

Few changes in prices have occurred since our last report, though business is active and sales are easily made. There appears to be less complaint about inability to get goods, than were heard when the rush first set in, the presumption being that the manufacturers have oiled up their rusty machinery and increased their facilities generally.

The rubber belting manufacturers at their meeting two days ago, took no action looking toward an advance in prices, though an effort was made by four or five, out of the sixteen manufacturers represented, to do so. The probabilities are now, that, notwithstanding the continued advances that have taken place in crude rubber, the time is not yet arrived for another lift in the prices of belting, hose, etc., though a special meeting for that purpose may be called at any time. The next regular meeting will be held the first Wednesday in December.

The recent and continued advances in the prices of hides and leather will, doubtless, necessitate another advance in the prices of leather belting before long—probably within the next three or four weeks.

The recent advance in the prices of lace leather left the wholesale rate as follows:

List price of ¾ cut lacing advanced from $1.25 to $1.50 per 100 ft.

Largest discount on cut lacing, 50%.

Lowest price of selected lacing weighing under 40 lbs. per dozen, 60c. per lb.

Lowest price of selected lacing weighing 40 lbs. per dozen, and over, 55c. per lb.

All subject to 5% discount, for cash, in 30 days. Further change in prices of lace leather is not thought to be imminent at present.

The Western File Co. have advanced factory rates to the trade, on their "Western" files, to 25% discount, and "Economy" files to 35%.

The advance to consumers in prices of files, nearly all American makers, amounts to about 15% average.

It is thought that any further material advance in the prices of American made files will open the door to the imported brands.

The American Screw Co. publish discounts to the hardware trade, as follows: Flat-head Iron Machine Screws, 65%; Round-head ditto, 60%; Flat-head Brass ditto, 35%; Round-head ditto, 20%; Taps for Machine Screws, 45%.

Iron Review.

NEW YORK, Nov. 7, 1879.

The demand is still fair, though more easily kept up with than formerly, and there are no material symptoms either of weakening or of any further advance. Best flange boiler plate advanced yesterday ⅛c. per lb.; also boiler rivets ⅛c. Some iron men, however, anticipate a weakening in prices at no distant day, though it is difficult to reconcile such a view with the general outlook as matters now stand.

A. B. Warner & Son, 28 West St., report boiler makers and other iron supplies as follows: Tank Iron, 4⅛c.; C. No. 1 Boiler Plate, 4¾c.; C. H. No. 1 ditto, 5c.; Best Flange ditto, 6⅛c.; Boiler Rivets, 5⅛c.; Sheet Iron, 4¾c. basis; Angle Iron, 4c.; Tee Iron, 4¾c.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling slip, New York, furnish us the following, under date of Nov. 7th, 1879:

The past week has been comparatively quiet in metals. Prices have receded somewhat from highest points (Lead being only exception). Market to-day is steady, with good jobbing demand, and a strong under tone. London cables £95 per ton for Strait's Tin; Singapore, $29 ℔ picul; Banca Tin, 26c.; Straits and Malacca, 23⅛c.@24c; Billiton, 23⅛c.@23⅛c.; "Lamb and Flag," 22c.; Antimony, Hallett, 17c.; Cookson, 18c.: Spelter, Western, 6¼c; Foreign, 6¾c.@6⅛c.; Pig Lead, 5¼c.; Ingot Copper, 21½c.@22c.; Nickel, $1.25@$1.50; Bismuth, $2.50; Solder, No. 1, 12⅜c.; Half-and-half, 14½c.

Situations Wanted—Help Wanted.

We will publish notices suitable for the above headings, applying to any of the machinery trades, and not to exceed four lines each (32 words), at the nominal rate of twenty-five cents for each insertion.

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A competent man can secure a permanent situation. Reference required.

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Situation wanted as a Foreman Boilermaker by a Scotchman with best of recommendations. Has been foreman over six years. Address, BOILERMAKER, office of AMERICAN MACHINIST, 96 Fulton street, New York.

As master mechanic of a small railroad. Have had nine years experience and have excellent references. Address Railroader, Box 381, Norwalk, Fairfield Co., Conn.

Situation wanted to learn the Machinist's Trade. Am willing to work and can furnish good recommendations. Address, James Dougherty, 342 East 60th Street, New York City.

A situation by a Pattern Maker. Has had 15 years experience; has been foreman of pattern shop for the last 5 years; has had some experience in mechanical drawing. Address Pattern Maker, American Machinist, 96 Fulton Street, New York.

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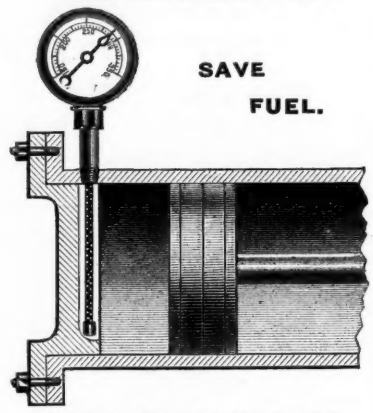

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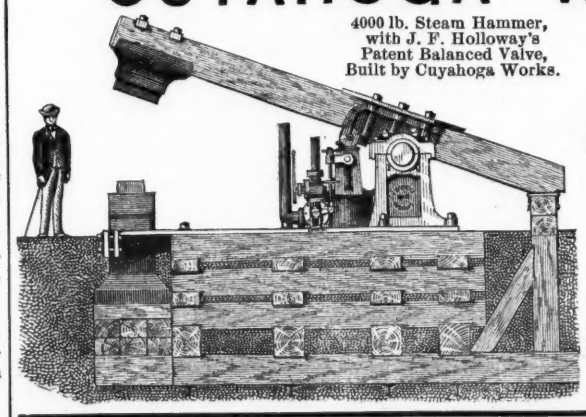
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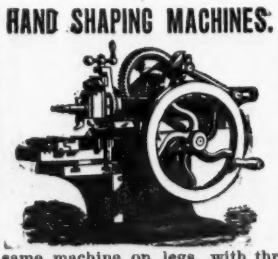

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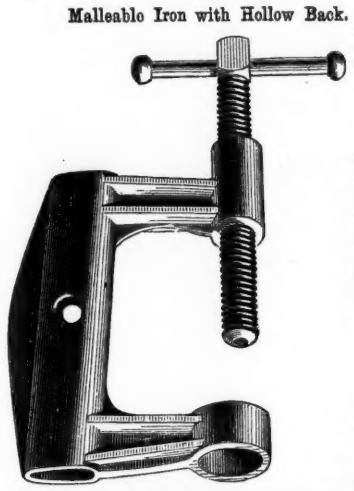

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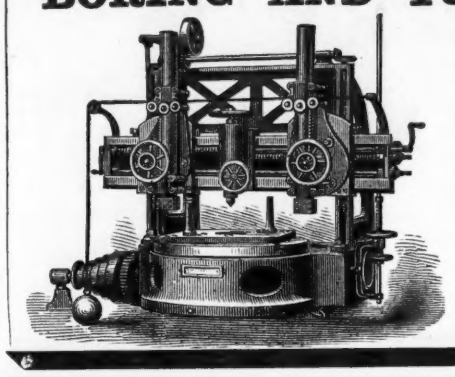

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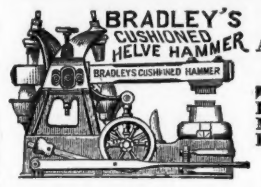

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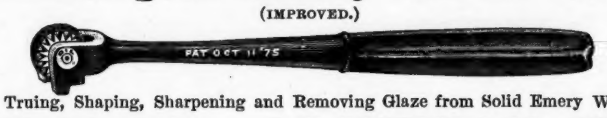

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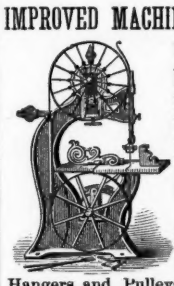

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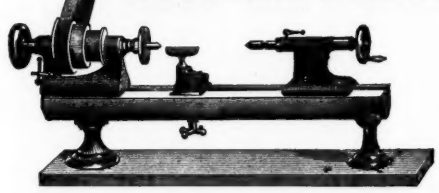

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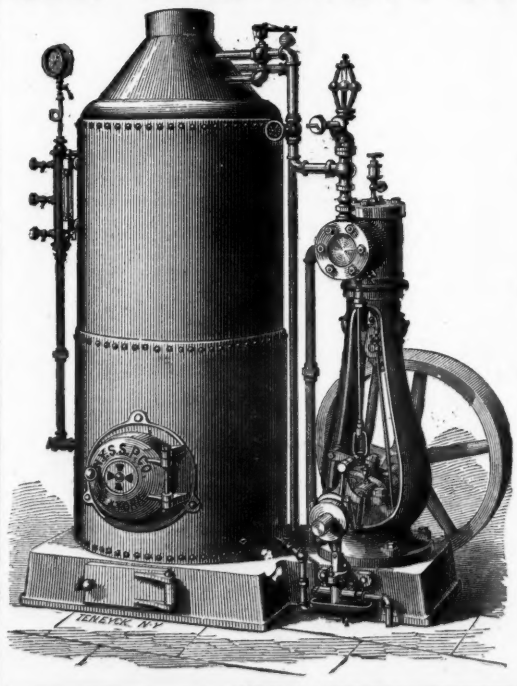

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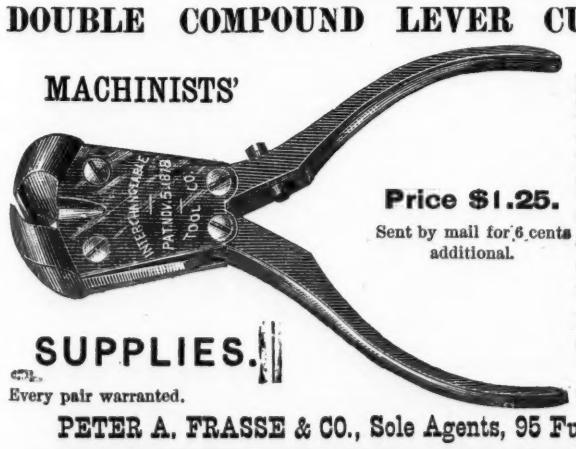

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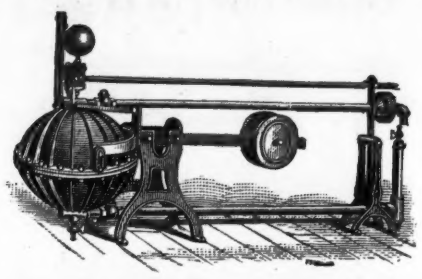

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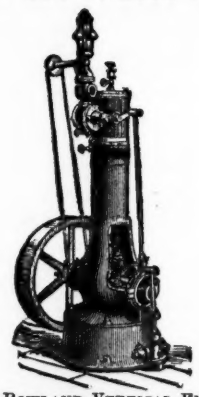

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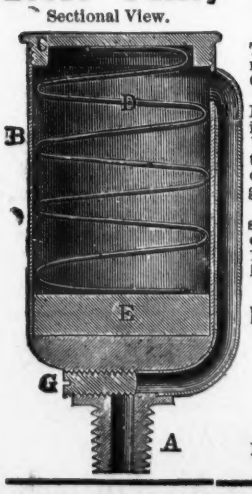

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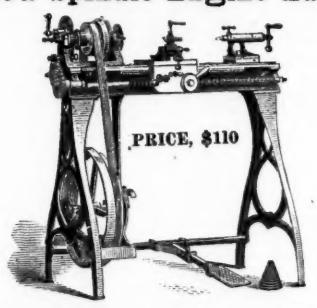

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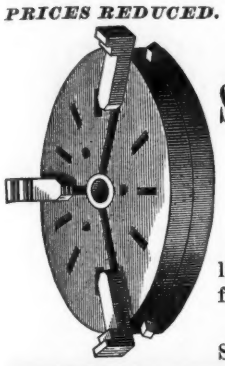

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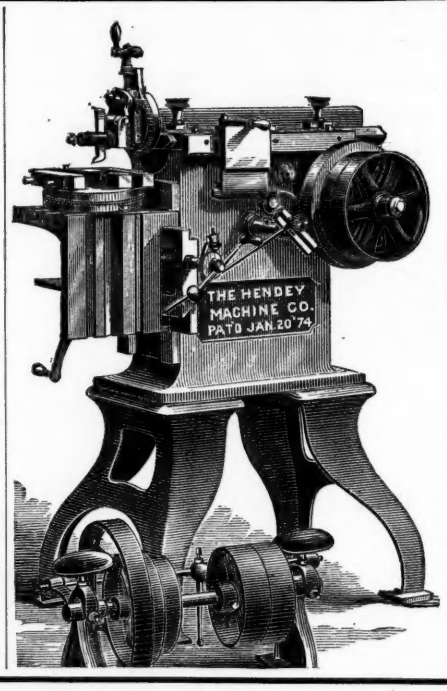

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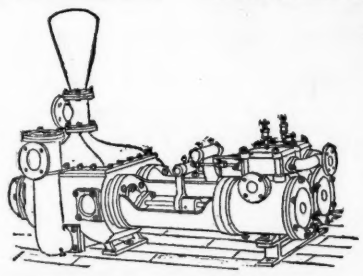

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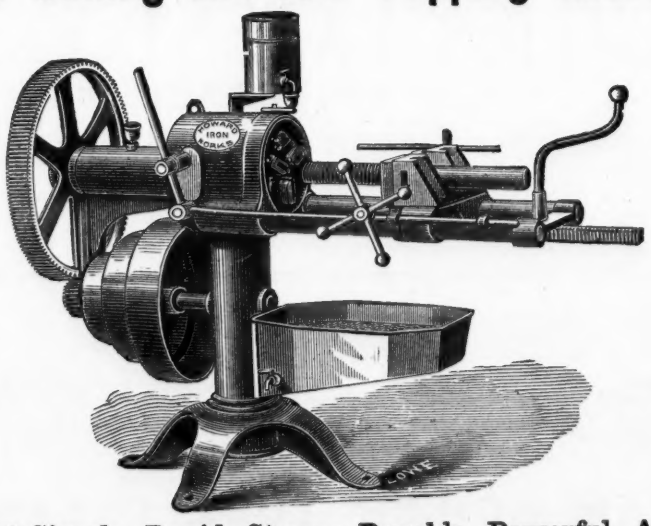

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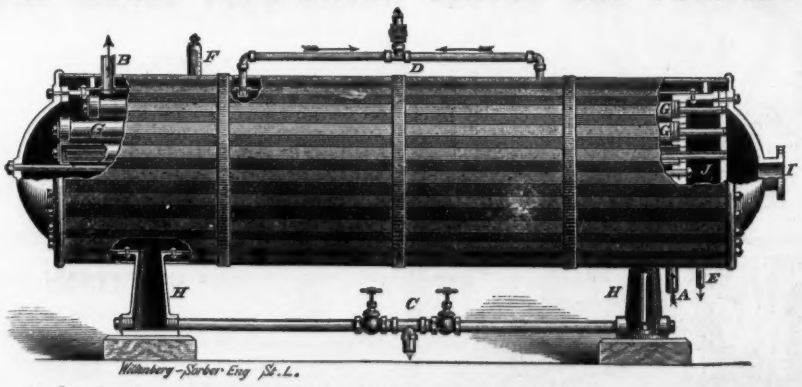

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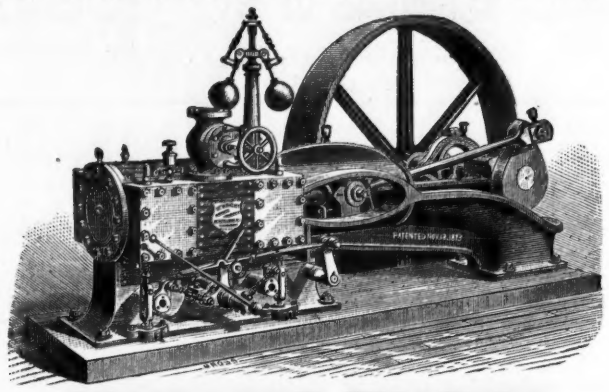

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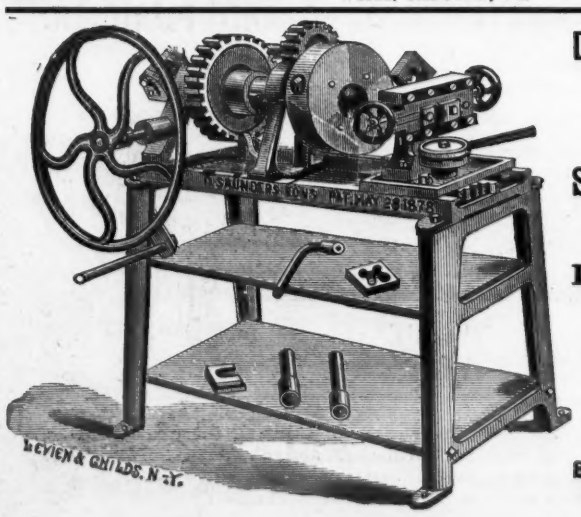

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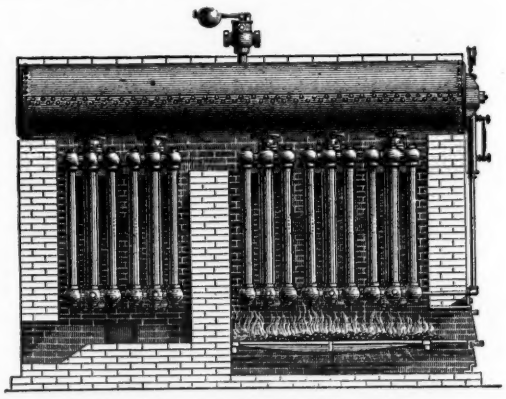

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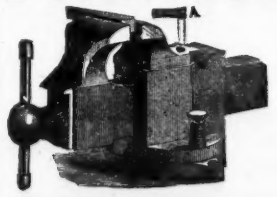

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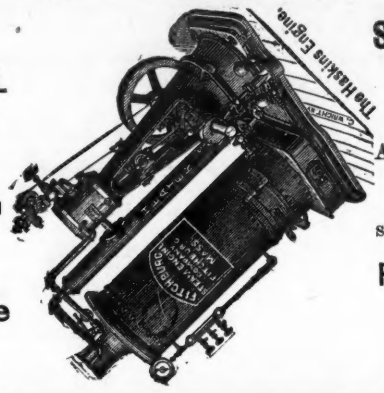

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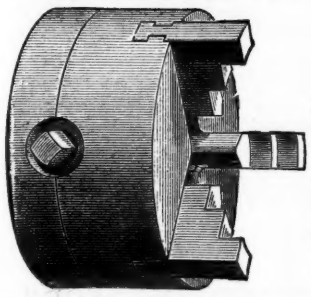

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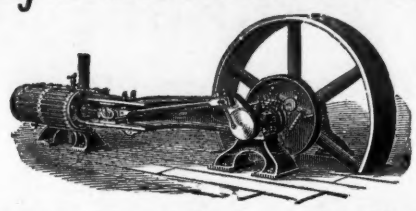

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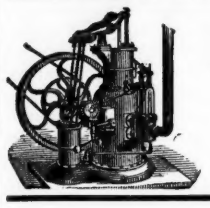

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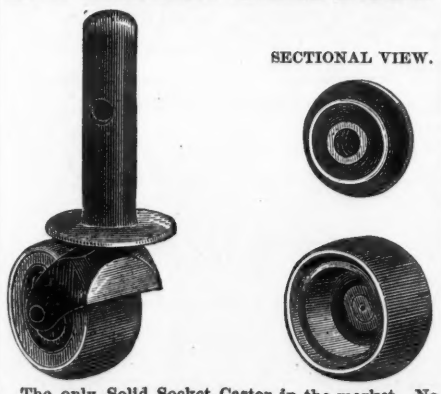

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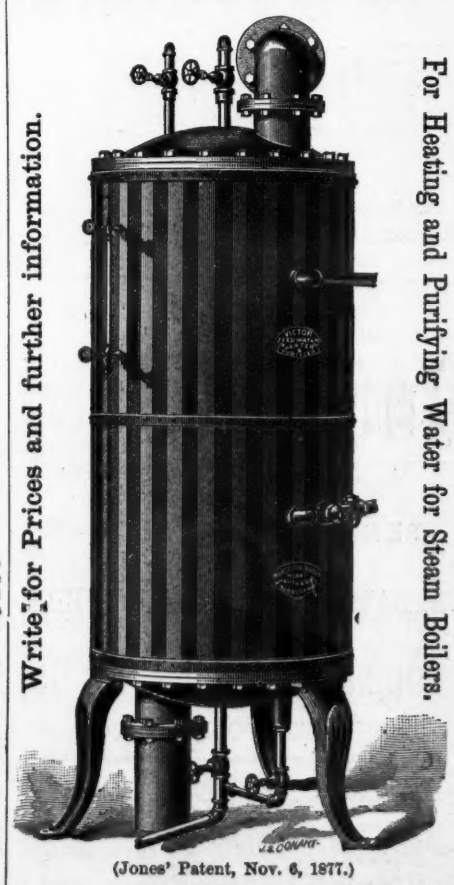

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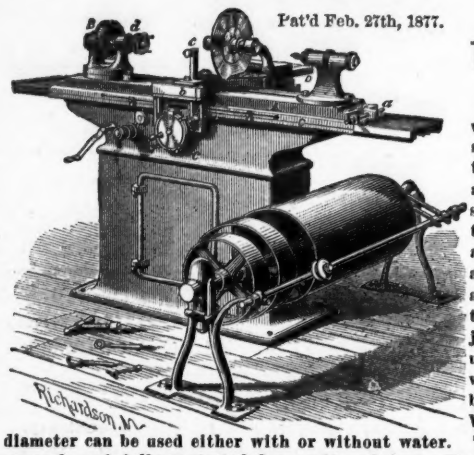

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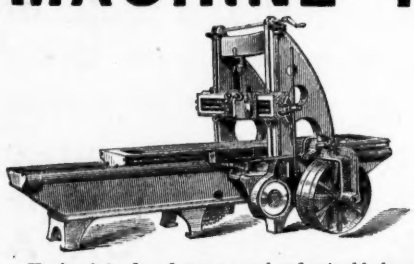

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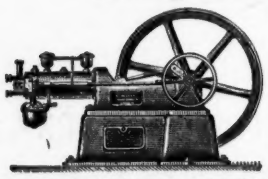

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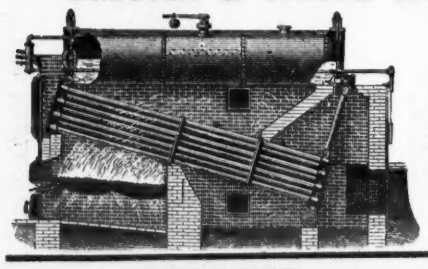

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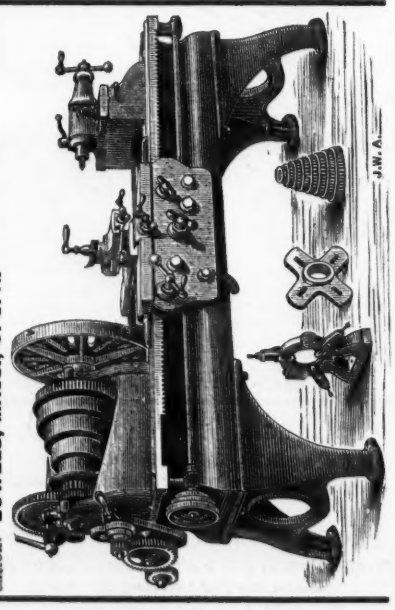

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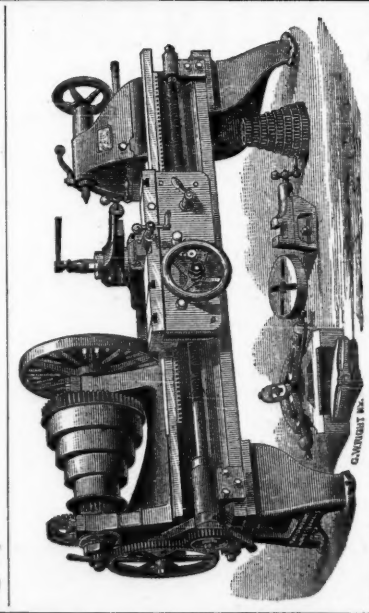

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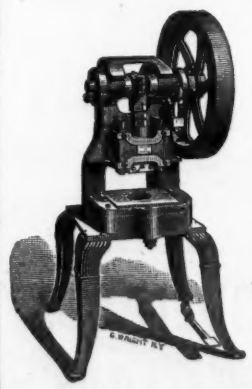

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